February 1954

MECHANICAL ENGINEERING

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ASME International Meeting, Mexico City, Mexico, March 10–12, 1954

IT WAS A LONG MEETING
–and all we talked about was ash

Yes, gentlemen, we know what you mean. Ash from burning coal is on the agenda of many meetings today —meetings of industrial and utility power-plant operators, air-pollution control boards, and civic-minded groups.

And when you're running a big power plant whose boilers consume many tons of coal every hour, ash disposal becomes a serious problem for discussion. You must talk about the high cost of equipment to trap fly-ash before it leaves the stack . . . the expense of paying for carting away tons and tons of this waste . . . and, of course, how to get the most out of the coals you buy, even if their ash content is high.

These and related problems have plagued industrial and utility power-plant men for years, the more so because they have a keen sense of responsibility for keeping their cities clean, and they are determined to keep operating costs down not only in their own interest but also that of the public.

We would like to make a suggestion. Put B&W's Cyclone Furnace on the agenda for your next meeting . . . and the day you put the Cyclone on your firing aisle you'll start enjoying advantages more and more power-plant men are discussing.

This more efficient method of burning coal converts most of the ash to molten slag, which drains continuously into a water pit for disposal.

If need be, the small amount of fly-ash remaining in the stack gases can be trapped by simple, inexpensive ash collectors and then returned to the Cyclone Furnace to be melted into slag. Result: Elimination of air pollution and of the costly mess of fly-ash disposal.

The Cyclone has many other advantages of interest—increased combustion efficiency, greater fuel flexibility, increased safety, and easier operation.

All this is accomplished—and is being proved in daily service—with *less equipment, less building volume, less manual labor,* and *less maintenance* than is possible when pulverized coal is used. For the Cyclone Furnace is a vast simplification of the entire process of coal preparation, combustion, ash segregation, and ash handling, which brings important savings right down the line.

Selected to fire some of the world's largest and most efficient boilers, Cyclone Furnaces are in operation—under a variety of operating conditions—in different parts of the country. Based on this intensive, long-range experience, we will be pleased to discuss the advantages which the Cyclone Furnace offers.

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BOILER DIVISION

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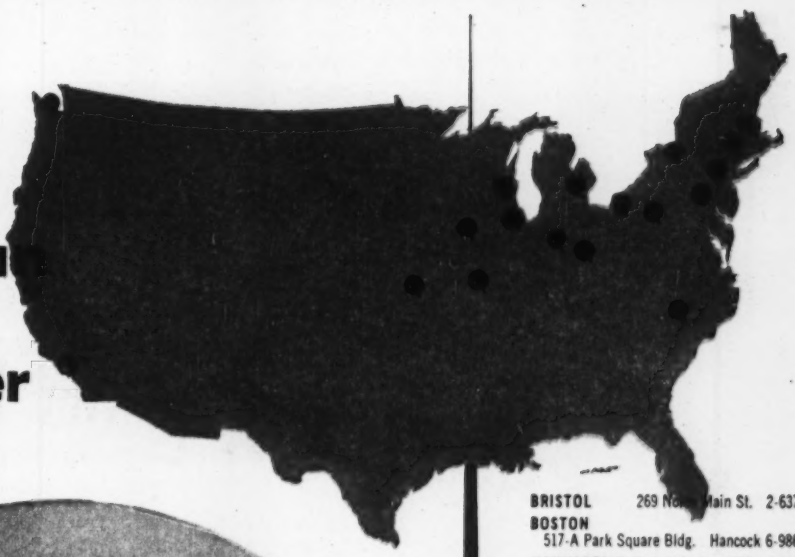
every salesman an engineer



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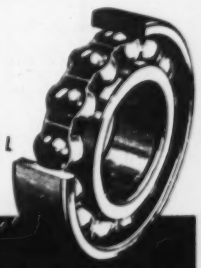

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MECHANICAL ENGINEERING, February, 1954, Vol. 76, No. 2. Published monthly by the American Society of Mechanical Engineers, at 20th and Northampton Sts., Easton, Pa. Editorial and Advertising departments, 29 West 39th St., New York 18, N. Y. Price to members and affiliates one year $3.50, single copy 50c, to nonmembers one year $7.00, single copy 75c. Postage to Canada, 75c additional, to foreign countries $1.50 additional. Entered as second-class matter December 21, 1920, at the Post Office at Easton, Pa., under the Act of March 3, 1879. Member of the Audit Bureau of Circulations.

Creation and development of mechanical equipment are major items in any Project X in any technological field. Either is a matter of professional knowledge, personal treatment, facilities, and time. With enough of all these factors, any research and development department can solve its own problems. When they're in short supply, it must turn to outside help.

Our Mechanical Division offers that help. Here is concentrated a greater diversity of specialized personnel and facilities than a single company can normally focus on a research or development project. Here, scientists blend their knowledge and talents with the industrial research experience of engineers and other technologists. This teamwork has a proven record of performance.

If you have a Project X which calls for outside help, the Mechanical Division of Arthur D. Little, Inc. is available to cooperate on one or more of the following bases:

1. Basic research
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3. Refinement of existing equipment
4. Prototype construction
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For further information or preliminary discussions, phone UNiversity 4-9370 (Boston) or write to:

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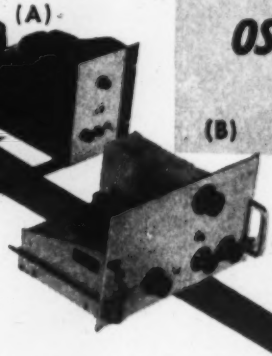
Creative Technology Since 1886

SANBORN 150 SERIES
OSCILLOGRAPHIC RECORDERS

The BASIC four-channel assembly includes: Cabinet, Recorder, and, for each channel, a BUILT-IN unit (A), which comprises a Driver Amplifier with frame, and a Power Supply with control panel.

(A)



(B)

A NEW design concept that brings even greater versatility to industrial OSCILLOGRAPHIC RECORDING

You have a CHOICE of readily interchangeable, plug-in Preamplifiers (B) for EACH channel, as described below.

The new Sanborn 150 Series offers greater operating efficiency and convenience, and encompasses a *variety of uses* which include the accurate recording of almost every phenomenon whose frequency spectrum lies in the range from 0 to 100 cycles per second.

A *wide selection* of plug-in preamplifiers, or "front end" units, such as (B) above, are completely interchangeable in any or all channels of the 150 Series amplifier section, where they simply plug in to the driver amplifier and power supply, (A) above, which are already in place.

Available plug-in Preamplifiers include: AC-DC, CARRIER, SERVO-MONITOR, DC COUPLING, LOG-AUDIO, and LOW LEVEL. Blank plug-in assemblies are also available for users to make input circuits for special measurement problems.

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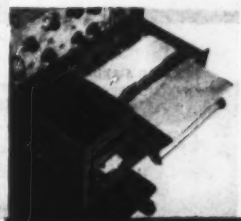
- Improved control of input signals by use of 1, 2, 5 ratios on attenuator.



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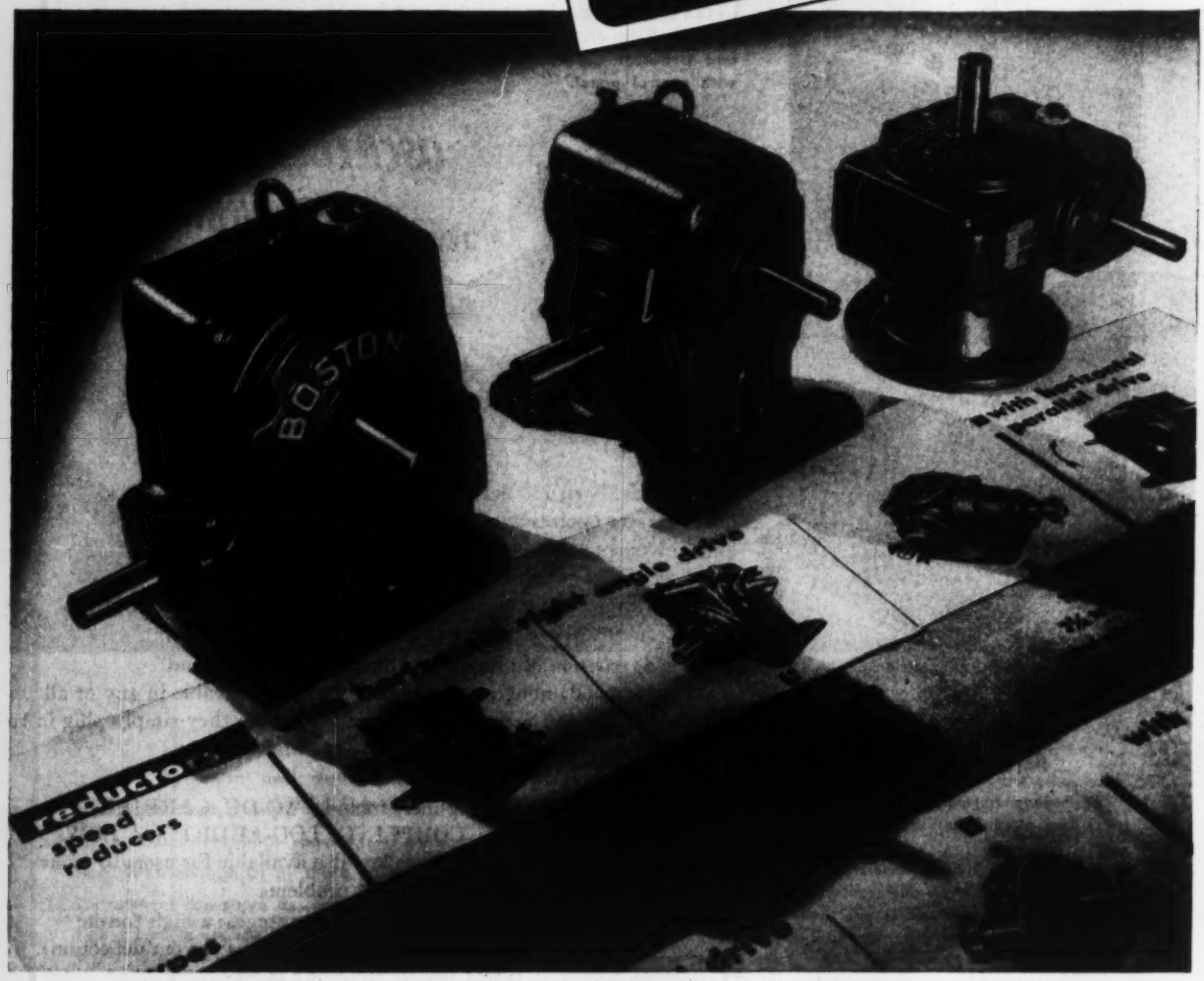

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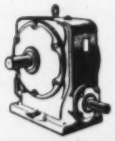

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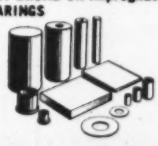

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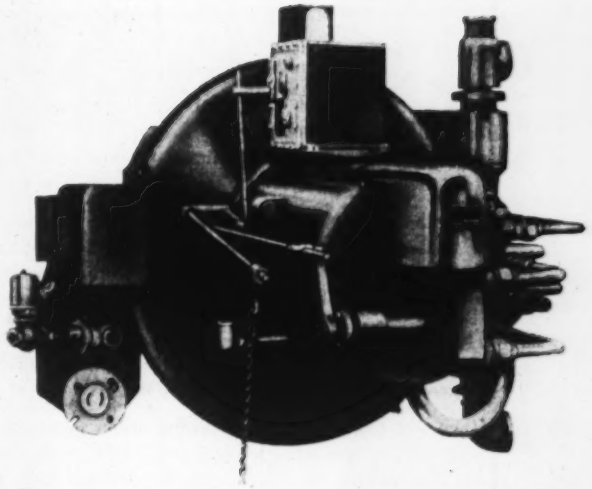

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For example, set up better, more efficient drafting room practices or faster reproduction methods. One of the most time-saving of these is the use of photocopying to eliminate unnecessary redrawing — when, for example, only minor design changes are called for.

This shortage of engineers — right now estimated at 60,000 — is expected to remain acute for several more years. The Engineers' Joint Council sees the annual crop of graduates falling 60% short of the need for at least the next three years.

Have you examined *your* drafting room practices, your record reproduction methods, lately, in the light of this shortage? Are you getting the most from the trained men you now have?

Your Peerless distributor — a specialist in photocopying methods — will be glad to go over your procedures with you and offer his professional counsel on where you can make greater savings of time through the wider use of better photocopying methods. He has the long experience, the factory training, to be of real help to you. Why not call him today? If you are not sure of his name, write us and we'll put you in touch with him.

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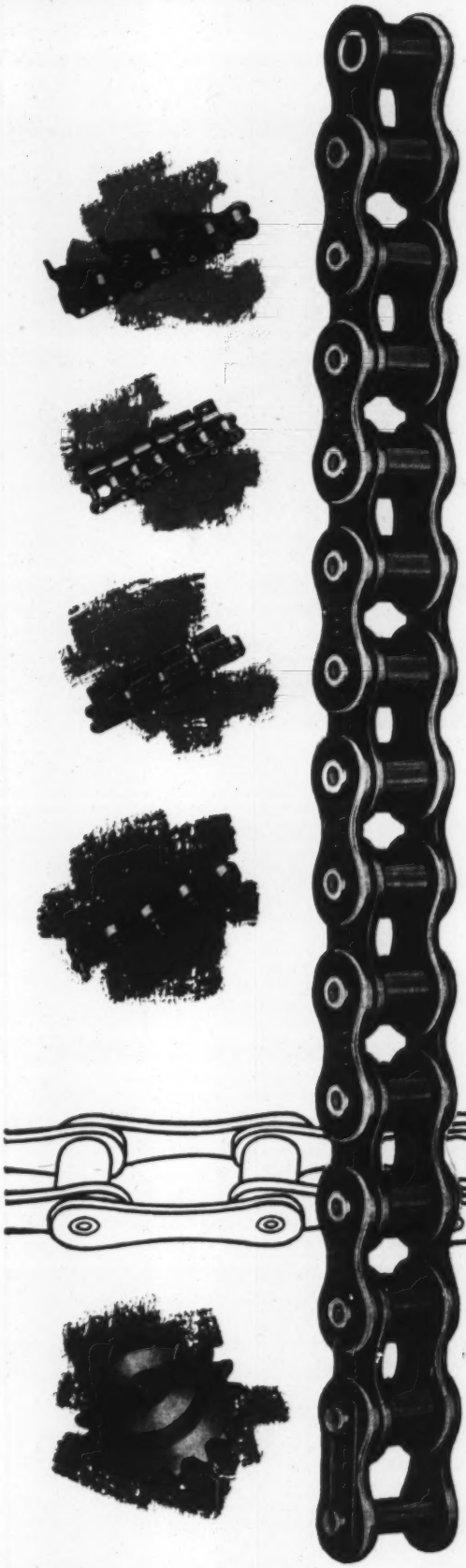

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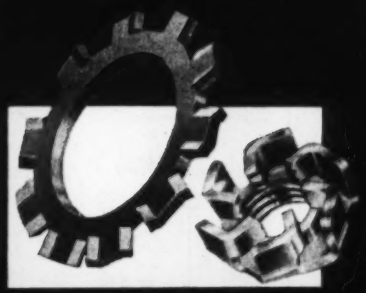

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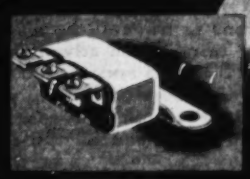

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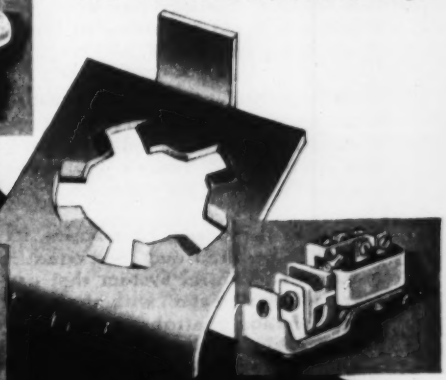

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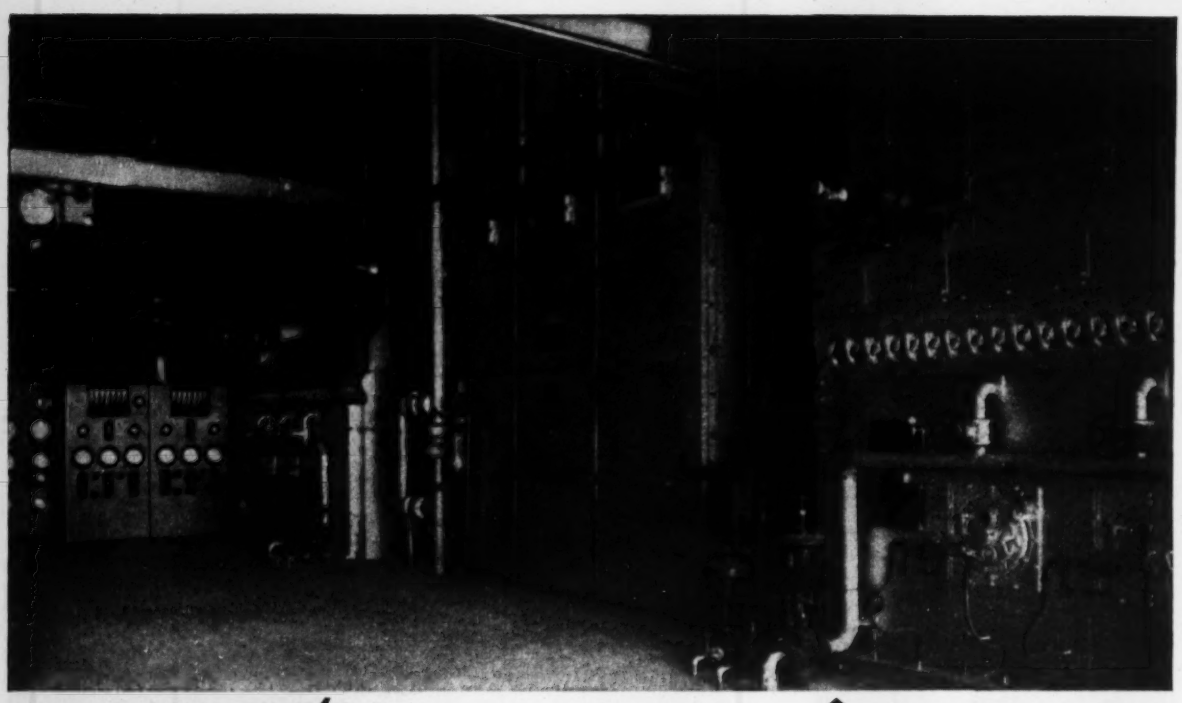


Boiler room at Kansas State College. Republic instrument panel is at left. Boilers are arranged for either gas or oil firing.

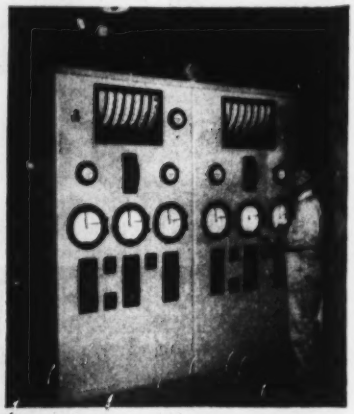
REPUBLIC *Automatic* COMBUSTION CONTROLS

Go to College to Cut Steam Costs

● At Kansas State College, a complete Republic combustion control system, feedwater level controls and instruments automatically operate two 50,000 pounds per hour boilers for maximum combustion efficiency. Fired by either oil or gas, these boilers generate steam at 225 psig and 500°F.

With Republic automatic combustion controls in this power plant, all loads, including "peaks", are met smoothly with steam output exactly matched to demand. Fuel costs per pound of steam produced are kept at a minimum 24 hours a day, seven days a week. Maintenance costs are kept low, too, by *continuous* proper operation of the boilers.

Whatever the size of your boiler, its draft arrangement, type or types of fuel to be fired and load conditions to be met, there's a Republic combustion control system that can bring these advantages to you. Our engineering staff, with more than 37 years *specialized* experience in combustion control systems, is at your service to help you get the system that exactly meets your needs. For your convenience, there's a nearby Republic field engineer to bring you all the facts. Write and make a date to see him soon.



Instruments on the control panel monitor boiler operation. If desired, the entire combustion system can be operated manually from this panel.

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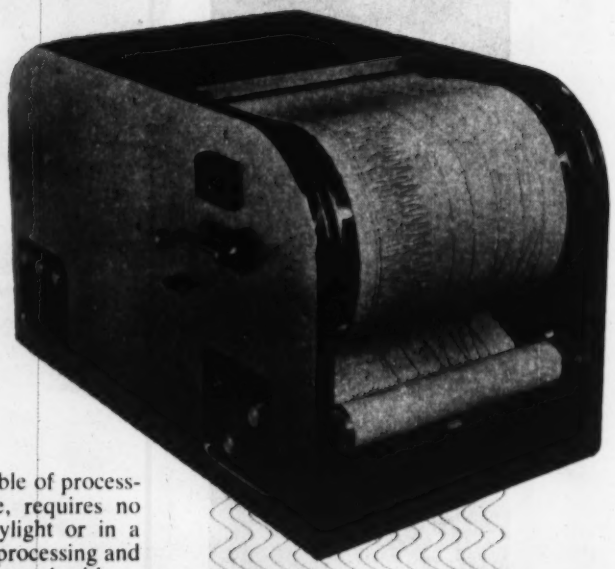
for paper oscillograms and other rolled paper photo-records



THE TEST ENGINEER'S DILEMMA—how to develop and dry large quantities of test data on rolled sensitized paper—is solved by Consolidated's new Type 23-109 Oscillogram Processor. Built for operation at the actual testing site, this self-contained instrument, capable of processing records as rapidly as 15 feet per minute, requires no external water supply and can be used in daylight or in a normally illuminated room. Simplified loading, processing and unloading techniques permit operation by personnel without previous photo-lab experience. The Type 23-109 processor is compact, portable and fast, requiring only electric power for the paper-transport motor and the drying drum. Where the problem is to save time in processing voluminous test data on photo-record paper, CEC's new oscillogram processor is the practical answer. Write for Bulletin CEC 1537A-X10.

Consolidated

Reduces time lag between test and interpretation of data.

Requires no dark room for operation.

Built for testing-site use without external source of water.

250 foot capacity for photo-record paper up to 12" widths.

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ANALYTICAL INSTRUMENTS FOR SCIENCE AND INDUSTRY

IT WILL PAY YOU TO LOOK INTO REVERE'S 70-30 BRASS TUBE— it paid SCHAIBLE!

Model #922—Schaible Faucet Assembly with Hydramold Spout. To date more than 1,000,000 Hydramold Spouts have been produced, and not one single failure reported from the field.

Close-up of Schaible Hydramold Machine (Patents Pending). Operation of this machine requires no special skill of the operator. One or any number of workpieces respond to accuracies of a thousandth part of an inch. Wall thickness of spout is uniform, nonporous, without inclusions, seams or joints.

A brass that does not have to be "tailored" to a job, but is made with accuracy in normal mill procedures, meets the unusual material requirements that the Schaible Company has in its remarkable spout fluid forming process called Hydramold.

The Schaible Company, Cincinnati, Ohio, is one of the larger manufacturers of strainers, valves and faucets, who have been more progressive in product design and methods of manufacture. Schaible requirements are exacting as to product quality control. This is especially true of sources of material, and when the company developed, designed and built its four new Hydramold machines to manufacture modern spouts from tubular material, the specifications became most rigid.

This was where the Revere Technical Advisory Staff entered the picture. Revere technical men studied the Hydramold process developed by Schaible engineers, and the unusual forming requirements, thereby helping establish the exacting specifications so that the mill and manufacturer developed mutual material control and process information.

The Schaible Company has made more than one million spouts by this new method without a single field performance failure—better spouts, states Schaible, produced by more economical means than conventional casting methods.

Today, there may be more costly spouts, but according to Schaible "There is no better spout than the Schaible Hydramold formed spout."

This case study is another example of the value of close cooperation between Revere and an exacting customer. The more we know about what you make, and how you make it, the better we can serve you. See the nearest Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N.Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y.— Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS

Here's all the data you need on Allegheny Metal Plates

For certified data on individual grades of Stainless Steel, use

ALLEGHENY LUDLUM BLUE SHEETS

There is a Blue Sheet for each individual grade of Allegheny Metal, giving full information on its physical and chemical properties and characteristics. Let us send you this certified, laboratory-proved data on the stainless grades in which you are interested.

ADDRESS DEPT. ME-50

WRITE FOR YOUR COPY!

For any job which involves the handling of large volumes, heat and high pressures—either singly or all at one time—Allegheny Metal solid or clad plates are produced in the exact stainless grade required to combat corrosion, oxidation and contamination of the product.

Some of these grades are *new* . . . comparatively recent developments of our research and experience as a pioneer and leader in stainless steel production. Others are improved versions of older analyses. The latest information on the entire subject of stainless plates is available to you in the booklet illustrated above—32 pages of valuable data on types, sizes, finishes, fabricating methods and uses, including ASTM and ASME boiler codes.

Specify "Allegheny Metal" for complete reliability in stainless steel plates, and write for your copy of the A-L Plate Book. ● *Address Allegheny Ludlum Steel Corporation, Oliver Building, Pittsburgh 22, Pennsylvania.*

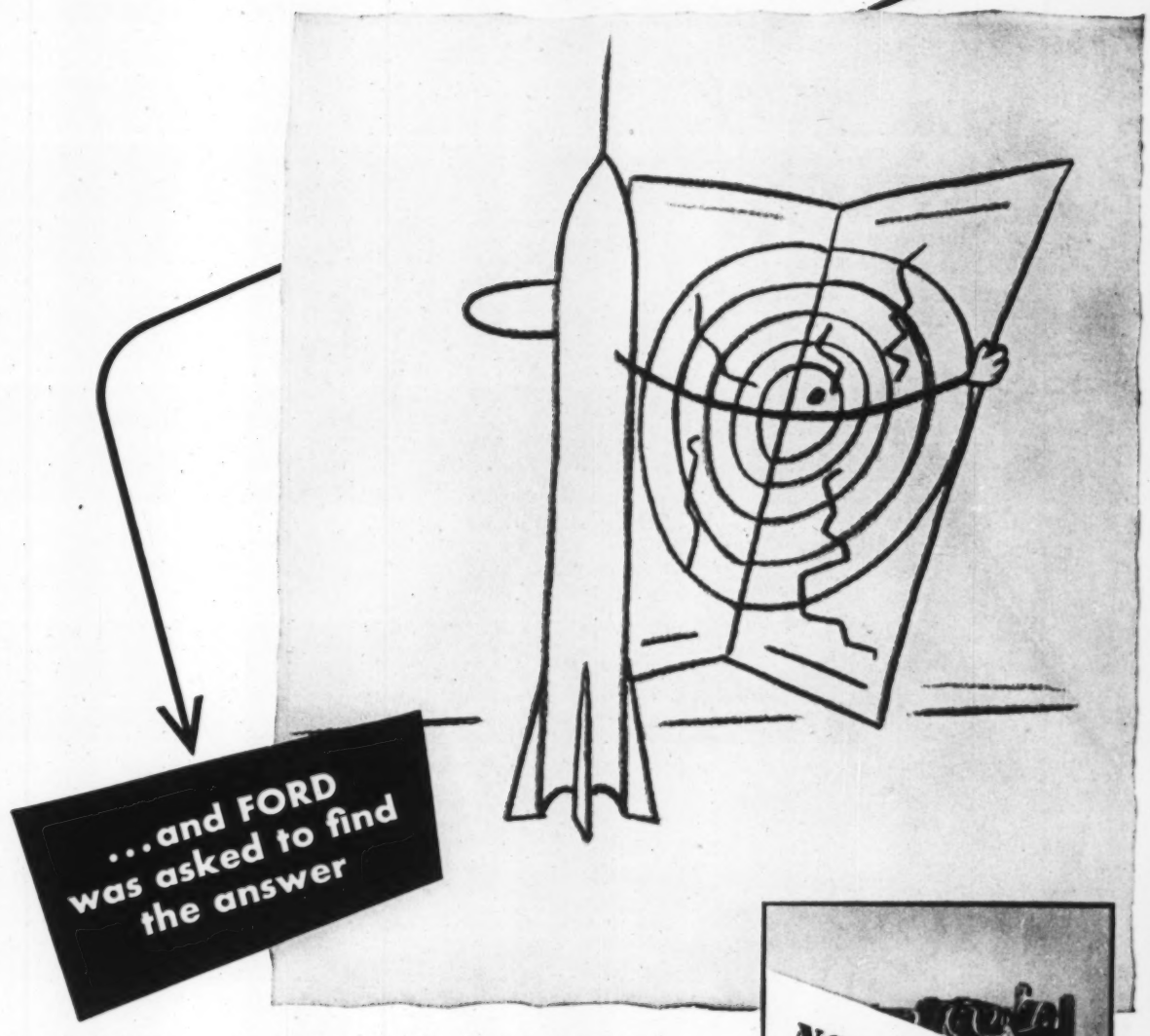
You can make it **BETTER** with

Allegheny Metal

WSD 4877

TIME-TESTED STAINLESS STEEL

HOW TO TEACH A MISSILE
to read a map



Zwish! And off goes a missile. But where? And how to stay on the right track? And how to *find* the target? That's the problem Ford Instrument is helping to solve.

This is typical of the problems that Ford has been given by the Armed Forces since 1915. For from the vast engineering and production facilities of the Ford Instrument Company, come the mechanical, hydraulic, electromechanical, magnetic and electronic instruments that bring us our "tomorrows" today. Control problems of both Industry and the Military are Ford specialties.

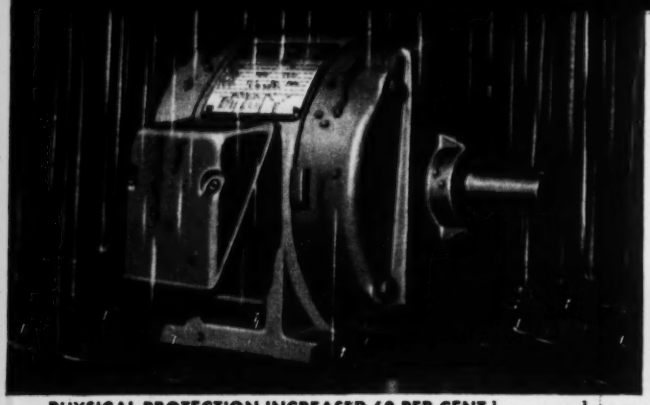
12

You can see why a job with Ford Instrument offers young engineers a challenge. If you can qualify, there may be a spot for you in automatic control development at Ford. Write for brochure about products or job opportunities. State your preference.

FORD

FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

YOU GET EVEN LONGER MOTOR LIFE



PHYSICAL PROTECTION INCREASED 60 PER-CENT by a complete redesign of cast-iron frame and end shields. This motor is suitable for many jobs where ordinary dripproof motors should not be applied.

EXTRA ELECTRICAL STRENGTH is assured by use of new polyester film insulation. A silicone coating, Dri-film,* virtually eliminates stator insulation failure caused by moisture.

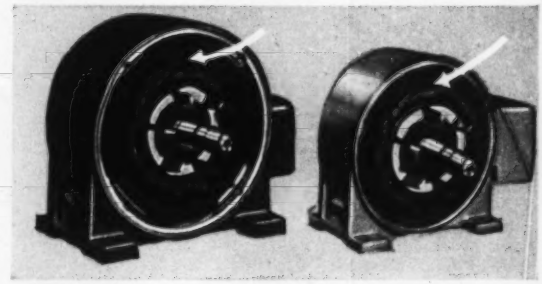
*REG. U.S. PAT. OFF.

TRI CLAD THE LEADER IN MODERN MOTOR DESIGN

GENERAL ELECTRIC ANNOUNCES...

THE ALL-NEW TRI 55 CLAD MOTOR

REG U.S. PAT OFF



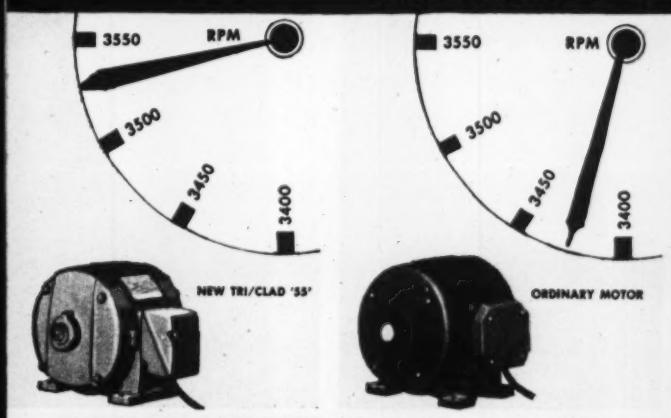
LIGHTER, SMALLER Tri/Clad '55' motors have been made possible through better use of space within the frame. Active materials (magnetic steel, copper) have not been sacrificed.

Complete Line of Dripproof, Enclosed Motors and Gear-Motors Available in Most Ratings in 1954

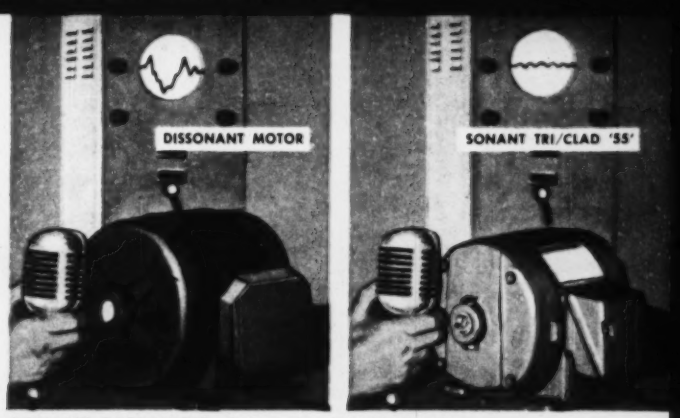
Here's the all-new Tri/Clad '55' motor — now available in NEMA 182 and 184 frame sizes.

You can get complete information on this dramatic motor achievement by writing for bulletin GEA-6013 on Tri/Clad '55' Dripproof motors, GEA-6012 on Tri/Clad '55' Enclosed motors, or GEA-6027 on Tri/Clad '55' Gear-motors, or by contacting your nearby G-E Apparatus Sales Office or G-E Motor Agent. General Electric Company, Section 648-1, Schenectady 5, N. Y.

YOU GET EVEN BETTER PERFORMANCE



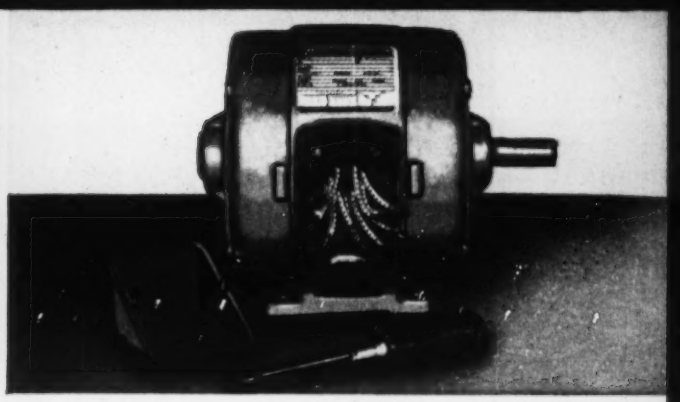
HIGHER FULL-LOAD SPEEDS is only one of many improved characteristics of this new G.E. motor. Above shows comparison of an ordinary motor with the Tri/Clad '55' — both rated at 3600 rpm.



SONANT OPERATION of the new Tri/Clad '55' motor has been laboratory tested and proven. Motor operates at reduced noise level, and operating sound is pitched to a more pleasant frequency.

YOU GET EVEN MORE INSTALLATION AND MAINTENANCE SAVINGS

NEW BEARING SYSTEM allows this motor to run longer than other motors without regreasing. One reason—greatly improved synthesized grease with 8 times the mechanical stability of ordinary grease.



EASIER TO SERVICE, the new Tri/Clad '55' has larger conduit box diagonally split for simplified wiring. Perma-numbered leads mean that even clipped and stripped wires are instantly identified.

Progress is our most important product

GENERAL ELECTRIC

CHIEF ENGINEER WILLIAM NOTE inspects the original Leslie Temperature Pilot taken from heater for its first overhaul. Leslie Representatives Frank Riggio (*left*) and Bob Gentner (*right*) look on.

DEWITT O. HESSLER, Laundry's President, joins Chief Note in examination of the original Leslie Pilot before reinstallation.

HOW SHOULD A 21-YEAR-OLD BEHAVE?

Temperature Pilot leads flawless life for 21 years prior to its recent, initial overhaul

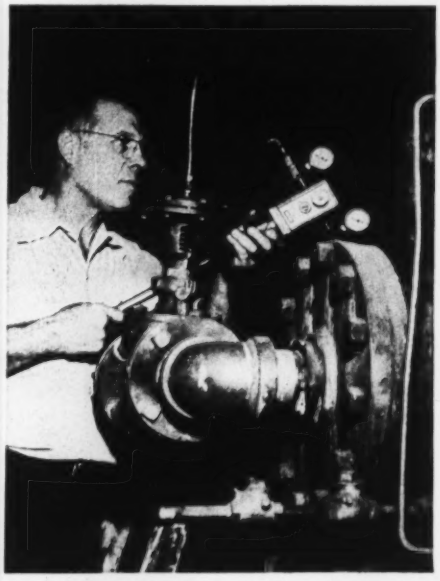
A 21-year-old Leslie Temperature Control Pilot had its "coming-out-party" recently at the Hessler Laundry, Paterson, N. J. The very first one of its kind ever made, it was installed at the Hessler plant back in 1933 by the firm's chief engineer, Bill Note—who also ordered the pilot's first overhaul in 21 years of continuous service.

The pilot was designed to control constant process temperature over extended periods without necessity for recalibration or replacement of thermal elements. The Hessler field test worked out so well that the pilot was left untouched after its initial setting, for 21 years.

Periodic inspections showed the pilot was doing the job without appreciable wear or need for *any* attention. This year, it was removed from the heater for a complete examination and after a quick clean-up, it was put right back into service.

Top performance suggests other applications

The outstanding behavior of this first pilot is being repeated today by Leslie Pilots in hundreds of other applications in all industries. The wide adjustable ranges (32°-400°F and 300°-600°F) make the pilots adaptable to most operating conditions. The fast-responding bi-metallic element responds to changes as small as ¼°F.



CHIEF NOTE REINSTALLS PILOT after *no-cost* overhaul. Parts showed no appreciable wear or corrosion after 21 years of continuous hot water heater service.

Send for Technical Data Sheet 464-14 describing Leslie Temperature Pilots and Controllers.

LESLIE CO. 287 Grant Avenue, Lyndhurst, New Jersey

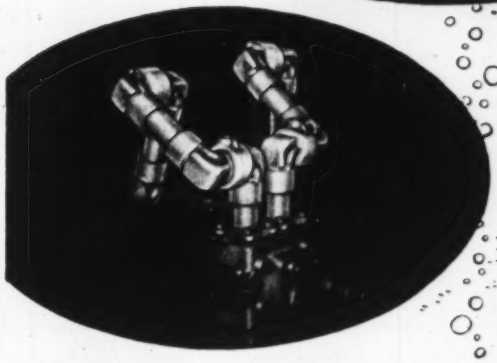
TRADE LESLIE MARK

TOPS IN QUALITY PRESSURE LEVEL AND TEMPERATURE CONTROLS

Since 1900

2814

Safety of its people and property, plus increased efficiency and economy of operation, were the chief considerations which turned Johnson Motors to Chiksan Swivel Joints.



Chiksan ball-bearing swivel joints installed on Lester-Phoenix die-casting machine helped Johnson Motors meet its fluid cost problems.

Johnson Motors die-casting department, one of the largest in the Middle West — and the largest captive plant in this country — selected Chiksan hydraulic swivel joints when it converted its machines from flammable oils to nonflammable hydraulic fluids.

Forty-eight package die casting machines are operated on a staggered three shift basis, producing more than 400 aluminum alloy die castings ranging from ½ ounce to 11 pounds in size. Hydraulic systems are operated at pressures up to 2000 psi, with average total die forces in the range of 300 to 500 tons. Castings are made at temperatures between 1100° and 1200° F.

Chiksan ball-bearing swivel joints have helped to reduce fluid losses from 40,000 gallons per year to 10,000 gallons. In contrast to former loss of from 1 to 3 gallons in repositioning bolted lines, Chiksan joints permit resetting of table level with virtually no fluid loss. Time consumed in resetting table levels has been reduced from 2 men and 1 hour to one man and 15 minutes of time.

This story is typical of the many ways thousands of manufacturers are using Chiksan ball-bearing swivel joints for greater safety, efficiency, and economy in their operations.

For Safety, Economy and Efficiency in your die casting department Chiksan has plans and applications worthy of your immediate and serious consideration.

Write CHIKSAN Engineering Research Division today for our NEW Catalog No. 53-C, Dept. 2-ME.

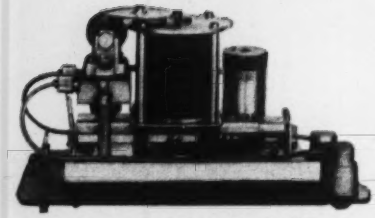
The Flow of Enterprise Relies on **CHIKSAN**

CHIKSAN TRADE MARK REG.

Representatives in Principal Cities

Ball-Bearing Swivel Joints

TRANSAIRE* to TRI-ACT* to TRANSET*



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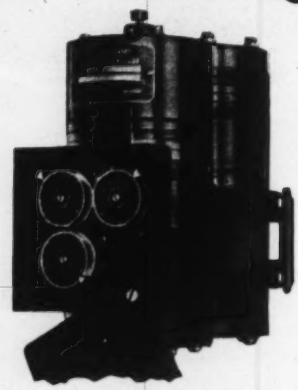

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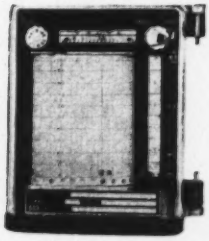
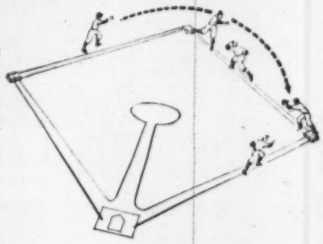


C

YOU DON'T HAVE TO WORRY ABOUT THIS TEAM EITHER!

YOU don't have to worry about the performance of the Taylor TRANSET System. And equally important, you don't have to worry about its maintenance, thanks to the exclusive TRANSET Plug-in feature and complete interchangeability of all receivers and controllers. Pull one instrument out—plug in another in seconds. It's that simple. Think what this means in terms of efficient, economical plant maintenance. Down time—and process interruption—is kept to the absolute minimum. Your instrument men can use their talents to maximum effect—and keep out of the operator's hair—because instruments can be taken to the shop for maintenance. And trouble, whether instrument or process, can be pin-pointed in the shortest possible time by simply plugging in a replacement unit of known performance.



The famous combination of Tinker to Evers to Chance could be relied upon for perfectly coordinated team work. The Taylor TRANSET System comprises three stars of the instrument world that work together to make the fastest, most dependable pneumatic transmission system.

Complete interchangeability of units is achieved by standardizing the output pressure range (3-15 psi) of transmitters, controllers and receivers. This means any controller and any receiver can be used with any (3-15 psi) transmitter. It also means a minimum stock of components.

The Taylor TRANSET System is truly the most versatile control system available today. Your Taylor Field Engineer will tell you how you can benefit from its features, or a post card will bring you **BULLETIN 98097.** Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada.

CHECK THESE ADVANTAGES:

1. You can plug in shop-adjusted instruments.

2. You can efficiently analyze process difficulties by quickly substituting a recorder for an indicator.

3. You can switch from the simplest to most complete controller in a matter of seconds.

4. Down time is kept to a minimum, since both controllers and receivers plug in.

5. Maintenance is unnecessary in the area of the panel. Checking can be done in the shop where full facilities are available.

6. One standard panel cut-out ($5\frac{1}{32}$" x $4\frac{5}{32}$") accommodates 12 different forms of recording and 11 different forms of indicating receivers.

7. You conserve panel space without impairing maintenance facilities.

8. Self-purging case for all receivers is especially appreciated in corrosive or dusty atmospheres.

9. Your plant can be kept running smoothly, without expensive shutdowns.

A. TRANSAIRE force-balance temperature or pressure transmitter. SPEED-ACT* gives rate action in the measuring circuit to compensate for process lags. Narrow range spans. Standard 3 to 15 psi output. Interchangeable unit construction. Temperature and Barometric Pressure Compensations.

B. TRI-ACT Controller. A force-balance controller with a new circuit . . . a new concept in process control. Booster relay air valve for faster response of control circuit. Wider response adjustments than ever before. Panel or locally mounted.

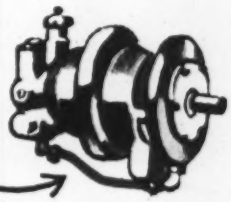
C. TRANSET Recorder. Fits 5 1/32" x 4 5/32" opening—a natural for graphic panels; a great space saver for conventional panels. Powerful actuation—bellows operated rectalinear movement. 30-day chart, 3-hour visible record. Everything needed for remote control.

*Reg. U. S. Pat. Off.

Taylor Instruments **MEAN ACCURACY FIRST**

FROM *the Bundy Sketchbook*
TO *jog a designer's imagination*

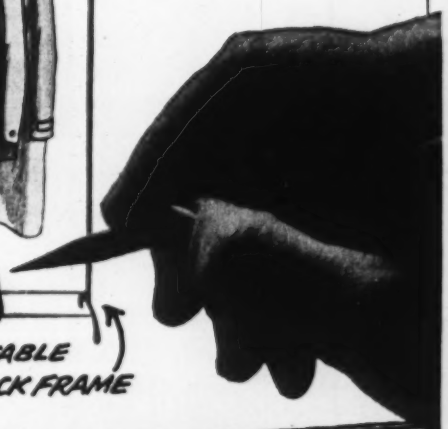
HIGH PRESSURE OIL PUMP LINES



FLINT HOLDER FOR CIGARETTE LIGHTER

THERMOSTAT FOR DEEP FAT FRYER

ADJUSTABLE CLOTHES RACK FRAME



REMARKS Baffled by a brand-new tubing headache? It may be old stuff to us. Our engineers have licked hundreds of tubing problems; may help lick yours. Why not let us put Bundyweld, plus our specialized engineering skills and unmatched fabrication facilities to work on your problem.

WRITE to us for catalog or for specific information on your problem.

BUNDY TUBING COMPANY
DETROIT 14, MICH.

WHY BUNDYWELD IS BETTER TUBING

Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness,

and passed through a furnace. Copper coating fuses with steel. Result . . .

Bundyweld, double-walled and brazed through 360° of wall contact.

BUNDYWELD TUBING®

DOUBLE-WALLED FROM A SINGLE STRIP

Leakproof
High thermal conductivity
High bursting point
High endurance limit
Extra-strong
Shock-resistant
Ductile

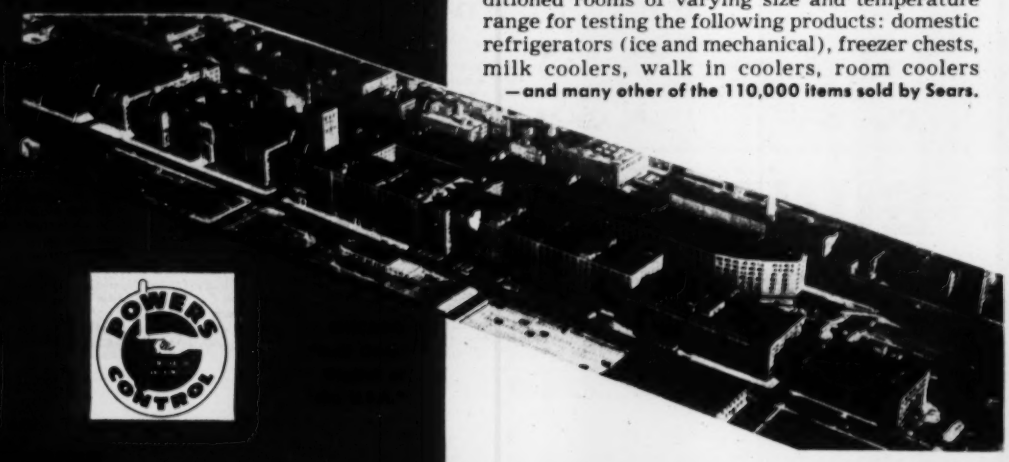
Lightweight
Machines easily
Takes plastic coating
Takes plating
Bright and clean
No inside bead
Uniform I.D., O.D.

Bundy Tubing Distributors and Representatives: ***Bridgeport, Conn.:*** Korhumel Steel & Aluminum Co., 117 E. Washington St. • ***Cambridge 42, Mass.:*** Austin-Hastings Co., Inc., 226 Binney St. ***Chattanooga 2, Tenn.:*** Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • ***Chicago 32, Ill.:*** Lapham-Hickey Co., 3333 W. 47th Place • ***Elizabeth, New Jersey:*** A. B. Murray Co., Inc., Post Office Box 476 • ***Los Angeles 58, Calif.,*** Tubesales, 5400 Alcoa Ave. • ***Philadelphia 3, Penn.:*** Rutan & Co., 1717 Sansom St. • ***San Francisco 10, Calif.:*** Pacific Metals Co., Ltd., 3100 19th St. • ***Seattle 4, Wash.:*** Eagle Metals Co., 4755 First Ave., South • ***Toronto 5, Ontario, Canada:*** Alloy Metal Sales, Ltd., 181 Fleet St., W.

Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.

"THE WORLD'S LARGEST DEPARTMENT STORE"

Since 1906 Sears, Roebuck and Co.



SEARS "COLDSPOT" REFRIGERATORS

Are Tested in their Modern Laboratories Regulated by POWERS Controls

"Satisfaction or Your Money Back"— Sears famous guarantee, is one of the reasons for their phenomenal growth and success. They were one of the first to establish testing laboratories to carefully check merchandise.

Photo above shows one of 4 Powers Temperature and Humidity control panels regulating 4 air conditioned rooms of varying size and temperature range for testing the following products: domestic refrigerators (ice and mechanical), freezer chests, milk coolers, walk in coolers, room coolers **—and many other of the 110,000 items sold by Sears.**

This and Over 50 Other SEARS Stores from Coast to Coast are POWERS Controlled

has used

Powers Room Type Thermostat pneumatically regulates heating and air conditioning systems. Outstanding for accuracy and dependability.

POWERS PNEUMATIC *Control Systems*

In Many of its Prominent Buildings

After 40 to 47 Years of Service in Sears Chicago Administration and Merchandise buildings, Powers pneumatic systems of temperature control are still in operation.

Fuel savings and greater comfort obtained here by the prevention of OVER-heating have paid a profitable return on the investment in Powers control. With today's higher fuel costs savings are larger than ever before.

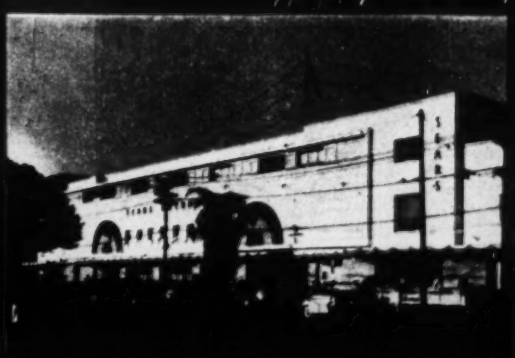
When you select a temperature control system, consider Powers. Users report lower maintenance cost and 30 to 50 years of dependable service.

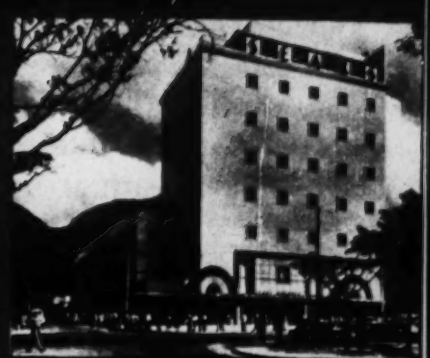
THE POWERS REGULATOR CO.

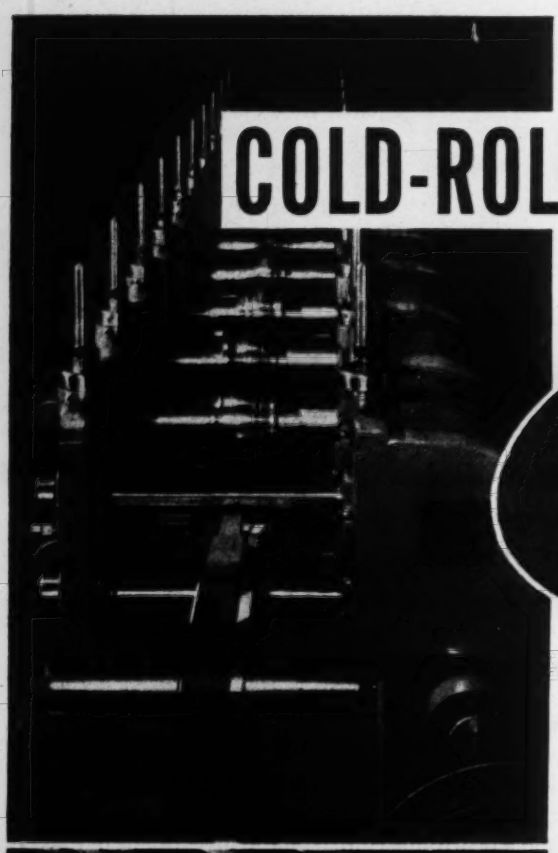
Skokie, Ill. • Offices in Over 50 Cities in the U.S.A., Canada and Mexico

OVER 60 YEARS OF AUTOMATIC TEMPERATURE CONTROL

(b42)







COLD-ROLL FORMING...

CHALLENGE

PROMISE

Cold Roll Forming holds a perpetual challenge to your skill and ingenuity in devising new ways to step up production and reduce cost. Infinite possibilities are suggested by thousands of existing applications in the high-production metal working industries.

New applications are constantly being discovered. Total production of Yoder cold roll forming machines now runs into billions of feet annually.

A Yoder roll forming machine can be arranged for doing other operations, such as notching, embossing, perforating, curving, coiling, welding, etc., at little or no extra labor cost. Yoder engineers are at your service in designing such multi-purpose production lines.

The Yoder Book on Cold Roll Forming discusses its varied functions and advantages, with scores of photos illustrating end uses of roll formed products. Ask for it.

THE YODER COMPANY
5499 Walworth Ave. • Cleveland 2, Ohio

Complete Production Lines

- ★ **COLD-ROLL-FORMING and auxiliary machinery**
- ★ **GANG SLITTING LINES for Coils and Sheets**
- ★ **PIPE and TUBE MILLS–cold forming and welding**

ENGINEERING YODER MANUFACTURING

Checking Mechanical Resonant Frequencies

FENWAL Incorporated, leading manufacturers of temperature control and detection devices, tell us:

"The equipment illustrated is used to determine the vibration resistance of Fenwal products in accordance with rigid aircraft specifications.

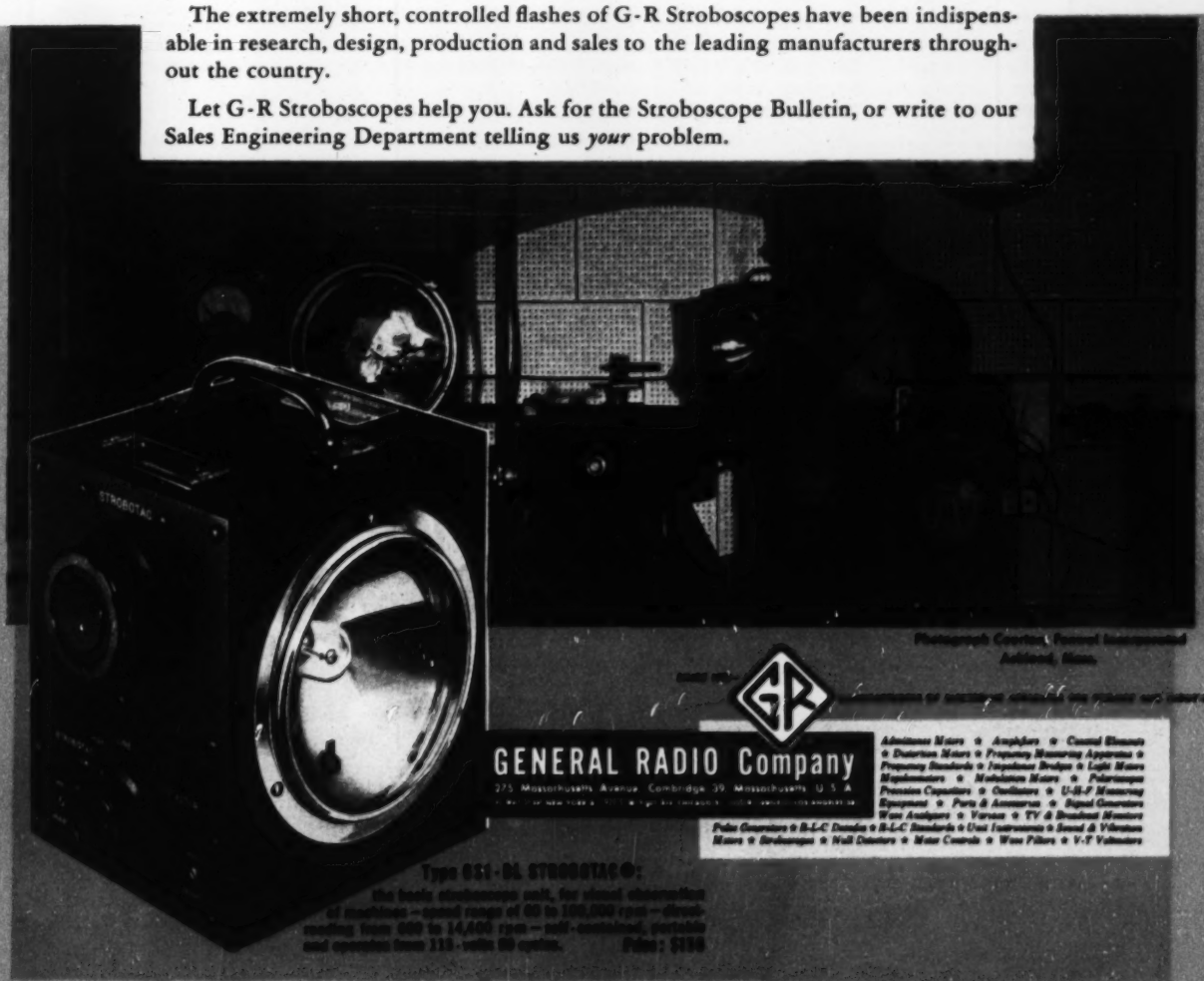
The engineer using the STROBOTAC® is searching for resonant modes in an aircraft unit-type overheat detector. The STROBOTAC visually slows down the apparent motion of the device to find any resonant frequency which may exist.

A permanent record of vibration in this equipment is obtained readily by means of the STROBOLUX. A variable-speed 16 mm motion picture camera has been fitted with a contactor to control the flashing rate of the STROBOLUX through the STROBOTAC. With this combination, very valuable records of exactly what happens to our products during vibration excitation at various frequencies and accelerations are obtained."

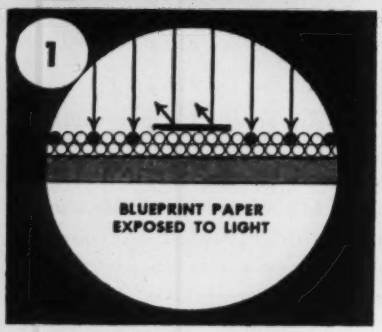
As has Fenwal, thousands of other users of G-R Stroboscopes have found the solution to many difficult mechanical and electro-mechanical problems.

The extremely short, controlled flashes of G-R Stroboscopes have been indispensable in research, design, production and sales to the leading manufacturers throughout the country.

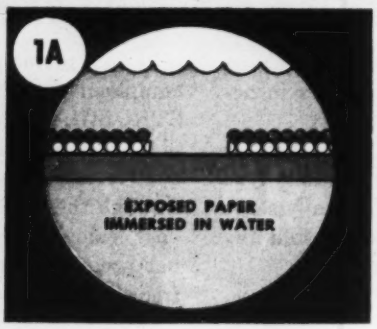
Let G-R Stroboscopes help you. Ask for the Stroboscope Bulletin, or write to our Sales Engineering Department telling us *your* problem.



Why is a blueprint



Simplified diagram of enlarged cross section of blueprint paper shows surface particles of the coating being struck by light. The coating, which is pale in color, contains two soluble ferric salts: a cyanide complex and an organic acid. Light reduces some of the ferric to ferrous ions in the exposed areas, producing a mixture of both. Opaque lines in a superimposed drawing prevent the light from reaching the coating beneath, as shown by the black bar in the center.

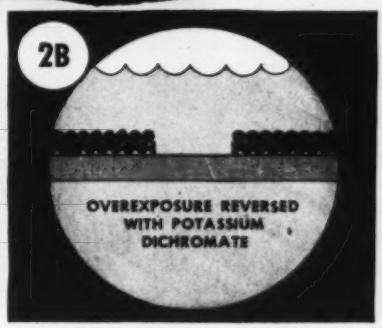


In the presence of water, the ferrous ions in the exposed areas react with the cyanide complex to form a ferrous-ferricyanide, which is Prussian Blue. (This is the famous blue pigment, insoluble in water, discovered in Berlin in 1704.) The areas that were shielded from light contain only the original soluble salts. These are washed away by the water, exposing the white paper beneath. The print then has white lines on a blue background.

Contrary to ordinary photographic processes, moderate overexposure of a blueprint has two good effects. It permits light to penetrate beneath the surface of the coating and thus to act in depth. It also reduces more of the surface salts from the ferric to ferrous condition, including the cyanide complex. But carried to an extreme, overexposure causes light to penetrate the opaque lines of a drawing with a resultant loss of contrast in the developed print.

BLUE?

When a moderately overexposed print is immersed in water, the ion mixtures react together. However, the colorless ferrous compounds that are formed on the surface of the coating cover up the layers beneath, and tend to hide the Prussian Blue color which has formed in the bottom layers. The print, at this stage, will have a grayish cast without full contrast.



Nearly every blueprinter, after washing the prints, immerses them in a solution of potassium dichromate, or peroxide. These are oxidizing agents that reverse the effect of too much light, changing a proportion of the ferrous ions back to ferric ions. In this way, with the help of overexposure, the entire thickness of the coating can be made effective in forming Prussian Blue. A deep, rich blue, contrasty print results.

● As one of the oldest reproduction processes, blueprinting has undergone little development until recent years. CHALLENGE* blueprint papers embody every valuable advance made in this time and, in addition, are produced with the extra skill and care that go into all K&E products. The presence of more colloidal Prussian Blue, plus a pre-coating process, enable CHALLENGE papers to provide more vivid white lines against a background of deeper, more intense blue.

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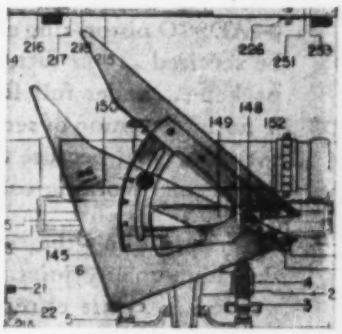

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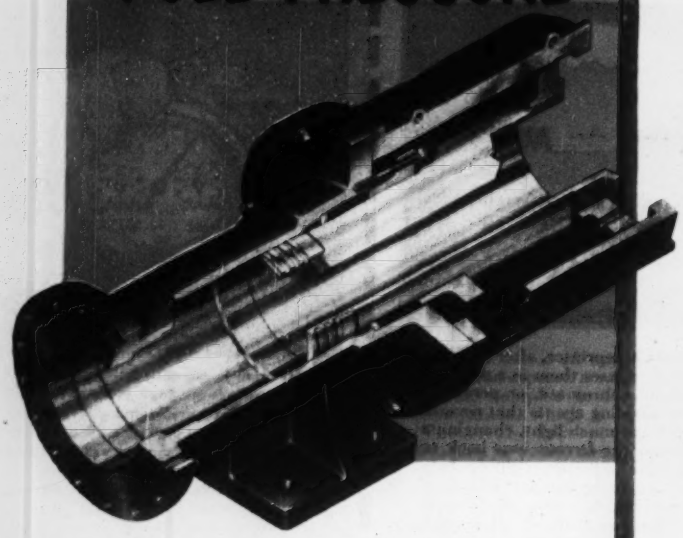

▶ ADSCO piston-ring expansion joints can be serviced . . . in fact, unpacked and repacked . . . under full line pressure. There is no interruption of service, no down-time for repacking, because the job is done under normal working conditions.

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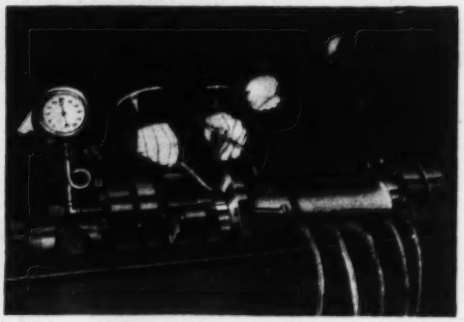
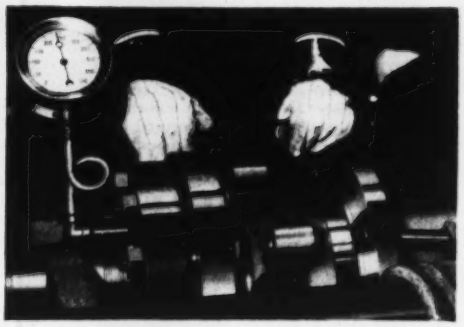


Last strand of packing being withdrawn from stuffing box.



Close-up photograph shows all packing removed. With steam at 240 lbs. pressure and with 300° superheat there is no trace of steam in the empty stuffing box.

With periodic adjustments of the gland, it may never be necessary to repack the stuffing box in an ADSCO piston-ring expansion joint. However, lack of maintenance may make it necessary at some time to do so and the job is easy with this ADSCO joint. The piston rings hold the line pressure during the unpacking and repacking operation. With the vent valve open, the vent chamber is at atmospheric pressure and, under this condition, no steam can enter the stuffing box space. Thus complete repacking can be done under full line pressure.

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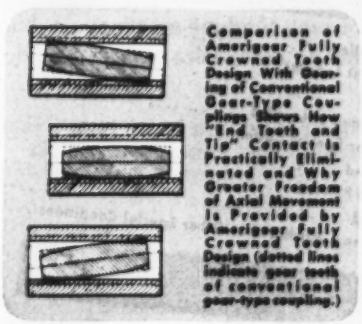

Comparison of Amerigear Fully Crowned Tooth Design With Gearing of Conventional Gear-Type Couplings Shows How "End Tooth and Tip" Contact Is Practically Eliminated and Why Greater Freedom of Axial Movement Is Provided by Amerigear Fully Crowned Tooth Design (dotted lines indicate gear teeth of conventional gear-type coupling.)

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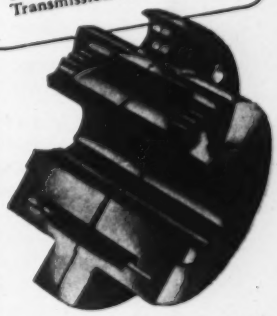

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Other Special Qualities	x		
TREATMENTS INDIVIDUAL OR COMBINED			
Quenched and Tempered	x	x	x
Annealed	x	x	x
Spheroidize Annealed	x	x	x
Normalized	x		
Stress Relieved	x		
CONDITIONS INDIVIDUAL OR COMBINED			
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Straight Lengths	x	x	x
Coiled		x	x
Flattened or Leveled		x	x
Gas or Special Cutting	x		
Pickled	x	x	x
Sand Blasted	x		
Oiled	x	x	x
Formed, Machined or Other Special Conditions	x	x	x
SPECIFICATIONS REQUIREMENTS INDIVIDUAL OR COMBINED			
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Macro-Etch	x		
Micro-Cleanliness	x	x	x
Restricted Chemical Analysis	x	x	
Special Mechanical Tests	x		
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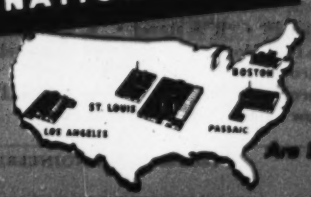

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MECHANICAL ENGINEERING

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View of Microscopic Pressure Probe . . .

. . . for measuring air flow in turbomechanisms at velocities reaching the speed of sound. The probe is being built on a Levin jewelers' type lathe by AiResearch Manufacturing Company, Los Angeles, Calif., from 0.072 and 0.018 tubing.

Editorial

MECHANICAL ENGINEERING

February 1954, Vol. 76, No. 2 · George A. Stetson, *Editor*

Regional Delegates Conference

MANY years ago when the program of the Annual Meeting of The American Society of Mechanical Engineers was much less extensive than it is today and the number of members in attendance was much smaller, it was customary for delegates of the Local Sections to assemble on the fifth floor of the Engineering Societies Building in New York to listen to the reports of the standing committees of the Society, to discuss Society affairs, and to offer recommendations on these matters for the consideration of the committees and the Council. Out of this attempt to provide a forum in which the members, through their Section representatives, could express their views and debate matters of concern to them, the present scheme of Regional Administrative Committee Meetings and the Conference of Regional Delegates, now held at Semi-Annual Meetings of the Society, was developed, and discussions and recommendations were given purpose and direction by means of a carefully planned group of topics organized by a National Agenda Committee.

The procedures currently followed are explained in a report to the members of the 1953 Regional Delegates Conference which appears on pages 212-214 of this issue. The recommendations of the Conference are submitted to the Council and the individual items are then referred to the Boards and Committees concerned for consideration and report to the Council. The Council then takes final action on each item and a report is prepared which states each item, the recommendation of the Regional Delegates Conference on that item, and the action of the Council. This report is available for distribution to any member interested in it, and in former years availability of the report has been announced in the ASME News. At the request of the 1953 Regional Delegates and with the approval of the Publications Committee and the Council, the report on the 1953 Conference has been printed in full in this issue of the ASME News.

An important aspect of the Regional Delegates Conference, as it was of the Local Sections Delegates Conference out of which it grew, is the stimulation of interest on the part of the individual member in the activities and operations of the Society. Presumably, the regularly appointed representatives of the Sections have reported to their constituents actions that have been taken by the Council on the recommendations of the Regional Delegates Conference. By printing the complete report of the recommendations and Council's actions on them, every member now has an opportunity to read the report for himself. It is expected that this new procedure will result in a more complete member understanding of Society affairs. If this expectation is realized, the recommendations of the 1954 Regional Delegates Conference and the Council's actions thereon will be reported a year hence.

New Type—New Format

WITH the February, 1954, issue, MECHANICAL ENGINEERING appears with a larger type face and a new format which noticeably change its general appearance. We hope the readers will approve the change and find it to be an improvement.

The cover, contents page, arrangement of the frontispiece, and the headings of the various departments of the magazine have been redesigned in what the experts feel to be the modern manner. The body type, which has a larger face, will appeal to many readers as being more readable than the type previously used. Display type, which is used for the titles of articles and for the subheadings which break up the solid expanse of text, have been made much heavier, thereby affording greater contrast and interest to the appearance of the pages. The arrangement of illustrations and a different treatment of captions may also be noted by readers who have an eye for make-up and typography. All in all, the magazine looks different, even though the text remains the same.

In changing its appearance, MECHANICAL ENGINEERING has abandoned an individuality it highly prized. When conformity to the typographical appearance of the better technical journals and trade magazines seemed to be indicated, every effort was made to preserve the dignity and good taste that advances in the printing arts afford. And it was necessary to adopt changes that would not add to printing costs. To a remarkable degree, these objectives were attained and it rests with readers to justify the results.

For years it has been recognized by readers and the editors alike that the body type used in MECHANICAL ENGINEERING was too small for easy reading. However, whenever suggestions were made that involved use of a larger type face, it was recognized that articles would require more pages, and hence involve greater

cost, or would have to be condensed to be printed in the same number of pages. Hence another change must be made to justify the larger type face. This change, which the editors have long desired to make, should be welcomed by readers although it may create some apprehension in the minds of authors. Wherever possible, articles are to be condensed. The result should be to increase the number of articles published each month and hence to introduce a greater amount and a greater variety of subject matter.

Shorter Articles

In deciding to condense articles for Mechanical Engineering the editors have in mind more than the Procrustean task of fitting articles set in a larger type face into the same number of pages they would have occupied if set in the smaller type formerly used. It is their hope that, by condensation, they will be able to present a greater number, and a greater variety, of articles in each issue. This decision should meet with the approval of readers. In a sense they should be getting more for the time spent in reading Mechanical Engineering without losing any of the essential ideas the authors expressed in their original manuscripts.

Condensation of articles for Mechanical Engineering will be conducted with full appreciation of the relationships which exist between the editors and the authors. In the journal of an engineering society these relationships have a particular significance. Such a journal belongs to its readers because they are members of the Society. But in a majority of cases authors are also members whose contributions to the journal are made for the benefit of fellow members. Without members there would be no Society; without authors, no journal.

Anyone who has had the privilege of long association with a membership organization, such as an engineering society, comes to a realization of its tripartite character, i.e., he knows it as a body of members, as a number of groups of members constituted as committees, and as thousands of individuals, each a separate and distinct person. Although this body of members as a corporation is competent to conduct its affairs and take decisions, one must never lose sight of the fact that it is composed of members, each of whom has a sense of personal worth and dignity and each entitled to respect and consideration as an individual. The decisions and opinions of the majority, expressed through accepted procedures, must prevail, but those of minorities and of individuals must be met in the spirit of sympathetic understanding they deserve. But neither as large a unit as the corporate membership nor as small a one as the individual member can effectively carry on the many purposes of the Society, and hence responsibility for results is vested in committees.

In selecting an article for publication, many considerations are involved—the readers, who in our case constitute the members of the Society; the committees, whose responsibility it is to plan programs and review papers for presentation and publication; and the author. Primary consideration must be given to the readers to present the material they desire and need in as readable and usable form as possible. The variety of desires and needs of readers is enormous and hence no single reader is ever completely satisfied. It may be assumed that an individual reader may be attracted to articles whose subject matter lies within the fields of his prime interests. It can be hoped that other articles contain material that will add to the reader's knowledge, enrich and stimulate his vision and understanding, and be so presented as to excite his interest and reward him for the time he spends in reading them. Condensation of long articles tends to increase the desire to read them, and in many cases copies of the original version will be available in preprint form for purchase by those who may wish the complete text.

Some forty odd ASME agencies are engaged in planning programs for the presentation of papers. Hundreds of men spend thousands of hours and a considerable amount of money for travel and correspondence in the discharge of their duties as committee members. This they do on behalf of the Society for the benefit of their fellow members and the progress of engineering. Jointly, they, and the authors of the papers on ASME programs and in ASME publications, vastly enrich year by year the literature of mechanical engineering. One concrete measure of the success of their endeavors, in addition to the satisfaction of having conducted a well-attended meeting, is in seeing the best of the papers they have selected published by the Society. By publication, the widest audience is reached, a permanency is attained for their efforts, and the areas of engineering knowledge in which their interest lies are broadened and brought to the attention of those who can profit from them. Without these committees authors would lack an important outlet for their papers and the Society publications would have little well-planned and carefully reviewed material to publish. By condensing papers, a greater number can be published.

When it comes to authors the editors realize that they are dealing with a very personal matter in suggesting condensation of a paper over which much time and thought has been expended. To anyone who has gone through the hard work of writing an article, the suggestion of another person that it might be just as good, or even better, if considerably condensed, has all the earmarks of infanticide. Yet once an article has been condensed, either by the author or by someone else, the result is frequently an improvement. When condensation of articles is approached in the spirit of rendering a service to the reader and for the purpose of promoting more and a greater variety of material in substantially the same number of pages, arguments in favor of it prevail. And for the satisfaction of the author it may be said that length tends to make readers put off reading what, in briefer space, may be of great interest and value to them. Since the objective of writing something is to have it read, authors should welcome whatever leads to that end.

Straightening Extruded Shapes

With Details of Some Recent Designs of Straightening and Stretching Machines

By Leo Hoffmann

Design Engineer, Hydropress, Inc., New York, N. Y.

THE ITEMS produced on extrusion presses are characterized by variety—variety in shape and size—from small intricate profiles used for instruments to large structural sections for aircraft. The upper limits of the large shapes will be determined by the capacity of the 12,000 and 20,000-ton extrusion pressses, designed for the USAF Heavy Press Program. Such presses will extrude shapes up to 50 sq in. in cross section and 32 in. in depth.

Variety of Shapes

Fig. 1 shows a few of many small shapes formed by extrusion. (Note the scale at the bottom of the picture.) Fig. 2 shows sections of larger shapes.

Most extrusions are more or less warped or twisted after leaving the die. Although the die imparts a highly accurate shape, the extruded metal is still in a plastic condition, and its own weight causes bending and deformation. Another cause for warping is the asymmetrical design of most extrusions, that is, the combination of a wide body with comparatively thinner legs or webs. This results in uneven expansion and contraction during the heat-treatment and cooling period with consequent additional distortion.

In order to restore the extruded shapes to the desired or commercial tolerances, a straightening process is necessary. For shapes of rather simple design, such as flats, squares, and rounds, roller straighteners may be used. Some of the smaller shapes, which require precision sizing, with careful tooling, may be cold-drawn and straightened at the same time. However, most extrusions are processed on stretching machines whose capacities range up to 1500 tons.

Stretcher Elements and Process of Stretching

The following main elements of a stretcher are shown in Fig. 3:

1 The frame, capable of carrying the load exerted by the hydraulic cylinder.

2 One movable grip head connected to the hydraulic cylinder.

3 Another grip head in a fixed position.

The operation of such a stretcher is as follows: Extruded shapes are gripped by the jaws which are mounted on wedges. The jaws are closed by means of hand levers in the smaller stretchers, or by air or hydraulic pressure on the larger types. After closing the jaws, hydraulic pressure is applied gradually to the main cylinder, until the yield strength of the shape is slightly exceeded and a 1 to 2 per cent elongation is reached. The pressure in the hydraulic cylinder is then released and the extruded shape contracts to an amount corresponding to the modulus of elasticity and the yield strength (after stretching).

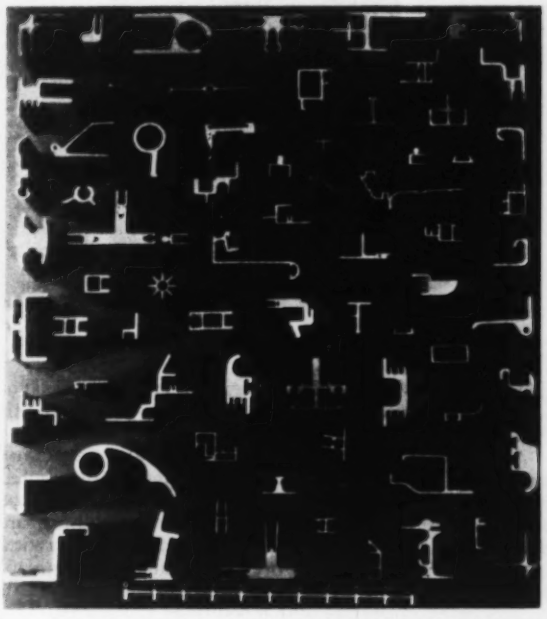


Fig. 1 Variety of small shapes formed by extrusion

This would amount to about $^1/_4$ per cent for one of the softer aluminum alloys and up to $^1/_2$ per cent for 75 S fully heat-treated.

If we consider processing a shape 100 ft in length with 1 per cent stretching, then in the case of the soft aluminum alloy the elongation would be 12 in. with an elastic recovery of 3 in., leaving a permanent elongation of 9 in. For 75 S, in a similar case, the elastic recovery would be 6 in., leaving a 6-in. permanent elongation.

The stretching operation, like any cold-working process, increases the yield point of the material. It is possible to improve the physical characteristics of the metal within certain limits by prescribing the amount of elongation during the stretching procedure. This is

Contributed by the Aviation Division and presented at a joint session of the Aviation Division and the Research Committee on Metal Processing at the Annual Meeting, New York, N. Y., November 29-December 4, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

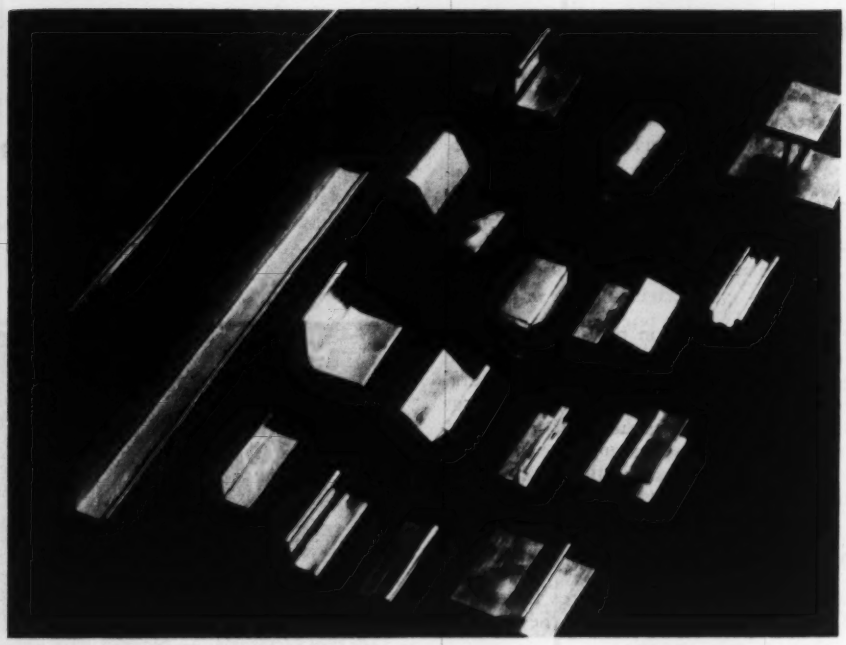


Fig. 2 Sections of larger extruded shapes

done frequently, and since it is easy to measure and regulate the degree of stretching, the results can be duplicated within close limits.

Another desirable effect peculiar to the stretching process is that the increase in yield strength is distributed uniformly over the cross section of the extruded shape and the internal stresses present before stretching are dissipated. Most cold-working procedures—drawing or roller-straightening—work the skin of the metal much more than the material nearer the center. This creates internal stresses which will lead to unpredictable distortions when the skin is removed during machining or polishing operations.

For this reason the stretching process is preferred for flattening high-quality sheets in spite of the less expensive roller-leveling process.

For large sections the stretchers are equipped with a detwister head as shown in Fig. 4. The head is rotated until it is in alignment with the twisted end of the shape before being clamped. Then the gripper jaws are closed over the end of the extruded shape and the head is rotated to zero position; at the same time pressure is applied to the main cylinder thereby stretching the shape. The shape is now in a complex state of stress. Each element is subjected to the tensile stress caused by the pull of the hydraulic cylinder and to the shear stress caused by the rotation of the head. When the tensile stress reaches the yield point, the material no longer can resist the torsional forces.

Consequently, the torque required for detwisting is comparatively small and the shape readily assumes a straight form.

Another advantage of the stretching operation is that it automatically subjects the extruded shapes to a very rigid test; that is, the load beyond the yield point which is applied during stretching is an assurance that

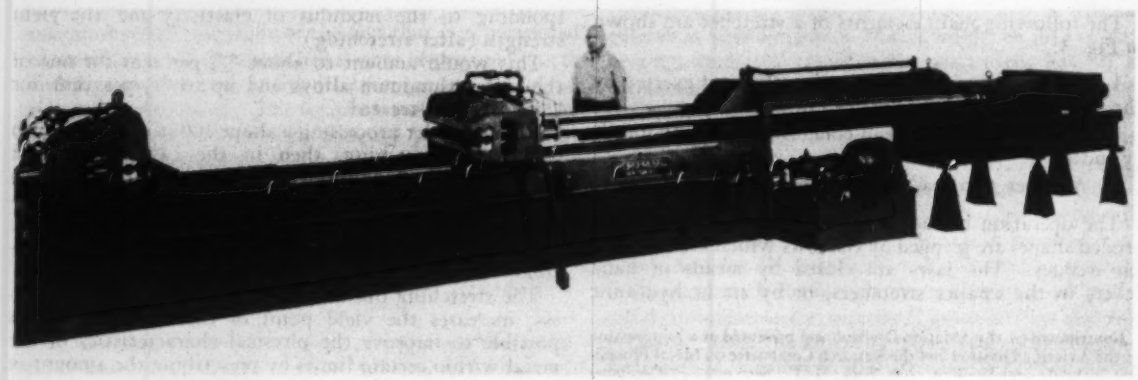


Fig. 3 Main elements of stretching machine

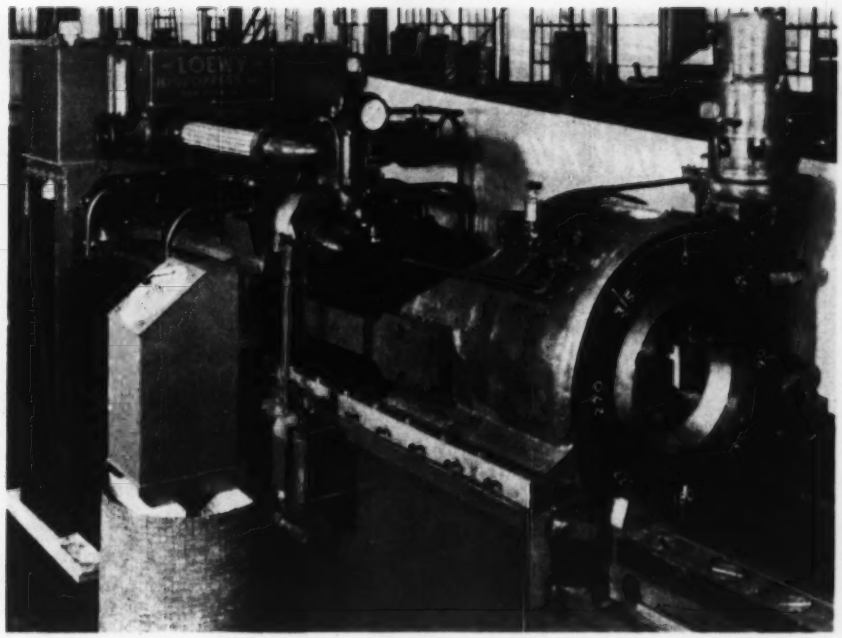


Fig. 4 Stretcher equipped with detwisting head

the shape will perform satisfactorily under the much smaller working loads. Defective materials will break in the stretching process and will be discarded. Sometimes, even an otherwise satisfactory extrusion may break near the grip jaw because of additional stresses existing at these points.

Breakage a Problem

Breakage presents a problem to the designers as well as to the operators of the machine. During the stretching operation a large amount of energy is gradually stored in the extruded shape, the framework of the machine, and in the hydraulic main cylinder. At the moment of rupture, this potential energy is suddenly released and transformed into kinetic energy, thereby accelerating the various parts of the machine and shape.

The shape itself, under the most extreme conditions, will fly from the point of breakage at a speed of 70 to 80 mph. In the larger machines, which handle shape weights comparable to the weight of an automobile, the kinetic energy may reach several million inch-pounds. To dissipate this energy special buffers are located in the grip heads. The usual design for such a buffer incorporates soft-metal inserts that can be deformed by the impact. Thus a large amount of energy can be absorbed in a small space and the problems of recoil are reduced considerably.

The energy stored in the frame is only a fraction of the energy stored in the shape, since the stresses in the frame members usually are kept rather low. However, the energy stored in the oil of the hydraulic main cylinder is equal to that stored in the shape. Since the weight of the frame and of the moving parts is much larger, the

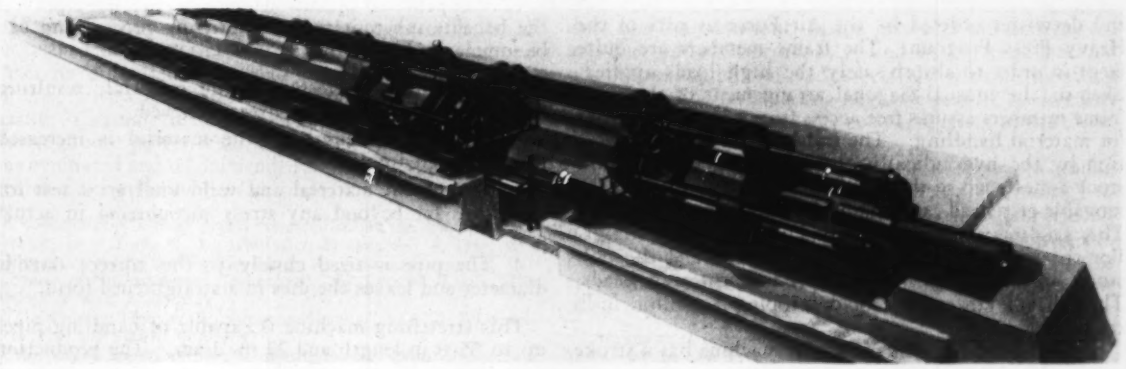


Fig. 5 Sketch of 1500-ton USAF stretcher and detwister

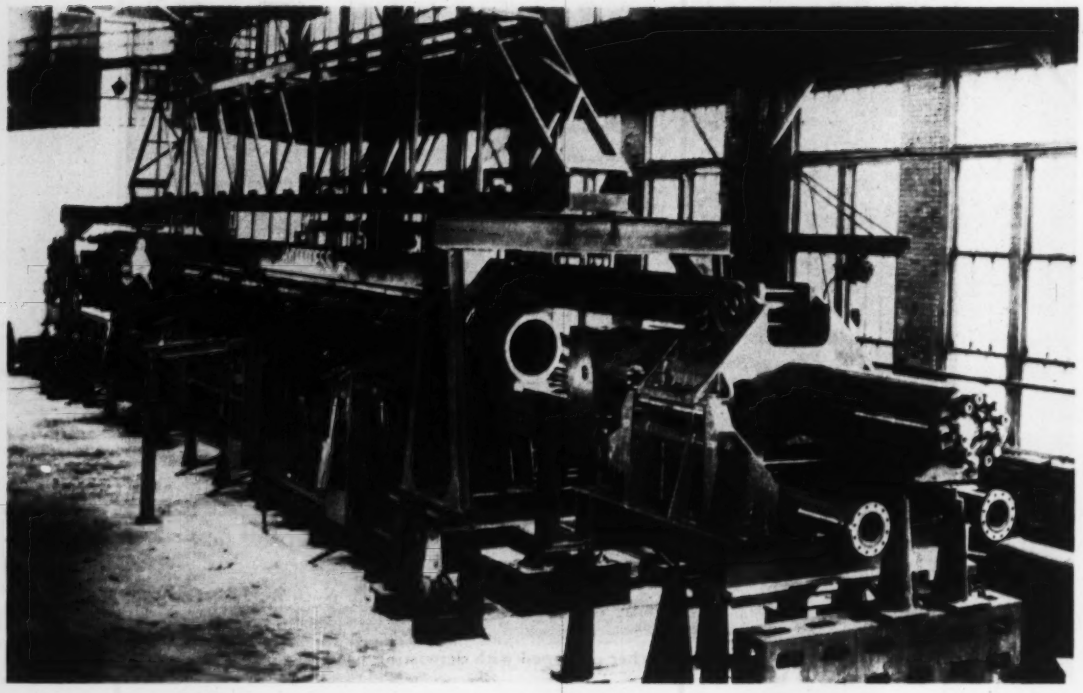


Fig. 6 Special application of a stretching process to welded-steel pipes

resultant acceleration is a relatively minor one. The energy contained in the oil is divided between the acceleration of the frame and of the movings parts (grip head, ram, crosshead, connecting rod) in inverse proportion to their respective weights. The moving parts are permitted to travel freely on their slideways under the impact and are finally stopped by hydraulic shock absorbers.

The frame itself is mounted on the foundation in such a way that it can slide a limited distance freely. A buffer of resilient synthetic material is mounted on a reinforced pier to absorb the energy and restore the frame to its original position.

1500-Ton Stretcher

Fig. 5 illustrates a perspective of a 1500-ton stretcher and detwister ordered by the Air Force as part of the Heavy Press Program. The frame members are quite large in order to absorb safely the high loads applied. Even so, the unusual diagonal arrangement of the main frame members assures free access from the top and front for material handling. The tailstock is locked in position by the hydraulically operated wedges. The tailstock is designed so that even in the locked position the movable grip head can be moved 6 ft by hydraulic means. This facilitates the loading and unloading of shapes. For the same reason, both the headstock and the tailstock are equipped with independent rotating heads. These heads are capable of developing 3 million in-lb torque.

The headstock of this particular machine has a stroke of 16 ft which permits it to accommodate extruded shapes of variable length without adjusting the tailstock position. Motors for the detwisting head and tailstock are d-c powered to permit sensitive control of speed and positioning by the operator. This stretcher is designed to handle extrusions up to 115 ft in length with a cross-sectional shape or size that can be accommodated within a circle of 32 in. diam.

Stretching Applied to Steel Pipes

Fig. 6 shows a machine which embodies a special application of the stretching process. Welded-steel pipes designed for natural-gas lines are placed into the loosely fitting dies. The pipe ends are then closed by hydraulic rams and are expanded diametrically by internal fluid pressure until they contact the dies at which point the diametral stretch amounts to $1^1/_2$ per cent.

This expanding operation imparts to the pipes all the benefits inherent in the stretching process and can be summarized as follows:

1 The internal stresses in the material, resulting from the bending of the skelp, are relieved.

2 The yield strength of the material is increased to a preselected point.

3 The parent material and weld undergo a test for soundness far beyond any stress encountered in actual use.

4 The pipe is sized closely to the correct outside diameter and leaves the dies in a straightened form.

This stretching machine is capable of handling pipes up to 55 ft in length and 22 in. diam. The production rate is about 60 pipes per hour or about 13 miles for a working day of three shifts.

Experts Appraise Nuclear Power

ASME Panel Summarizes Status of and Prospects for Power Reactors From Technological, Economic, and Legal Viewpoints

NUCLEAR reactors have been in existence only ten years and are based on a technology less than 14 years old. It does not take much courage to predict that some day nuclear power will compete with fossil fuels for both central station and propulsion use. One very important step toward possible realization of economic nuclear power will be the construction of one or more large-scale plants, even though costs may be higher than for conventional stations. The legal problems can, and indeed must, be solved although the co-operation of Congress and the state legislatures may be required.

Technical Aspects of Nuclear Power

Of the ten possibilities, Table 1, which have been considered for power reactors, Mr. Landis considers the following the most promising for the foreseeable future: The pressurized light-water thermal converter and the pressurized heavy-water thermal reactor, with the sodium-cooled graphite converter a possible alternate for the latter; while the most promising long-range types are the sodium-cooled fast cast-plutonium breeder and the aqueous (heavy) homogeneous breeder. These choices, he admits, are colored by a hope that boiling within a reactor some day will be proved feasible.

Mr. Landis reviewed briefly the characteristics of the several reactors under study. Type IA(1) is a pressurized version of the Hanford production reactors that could be built full-scale today, though large and rather uneconomic. Type IA(2), a reincarnation of the Daniels pile, is relatively simple but has been studied and discarded by the Commonwealth Edison-Public Service group (see Table 2). Type IA(3), promoted for several years by North American Aviation, was favored by Monsanto-Union Electric group for dual-purpose production of chemicals and power.

In co-operation with the National Laboratories, H. K. Ferguson Company and Walter Kidde Nuclear Laboratories have studied Type IB(1), which is based on experience with the "materials testing reactor" and "submarine thermal reactor." The recently announced Westinghouse power-reactor project is of this type. It was evaluated and recommended highly by the Commonwealth Edison-Public Service team.

Table 1 Possible Power Reactors

Reactors which have been considered for power applications include the following:[a]

I Thermal—
- A Graphite-moderated
  - (1) Pressurized light-water-cooled, natural, or slightly enriched uranium
  - (2) Pressurized helium-cooled, natural, or slightly enriched uranium
  - (3) Sodium-cooled, partially enriched uranium
- B Light water-moderated
  - (1) Pressurized light-water-cooled, partially enriched uranium
  - (2) Pressurized circulating-fuel solution, enriched uranium
- C Heavy water-moderated
  - (1) Pressurized heavy-water-cooled, natural uranium
  - (2) Pressurized light-water-cooled, natural, or slightly enriched uranium
  - (3) Pressurized circulating-fuel solution, enriched uranium

II Fast—
- A Sodium-cooled plutonium (cast or machined fuel)
- B Homogeneous mixture or solution of liquid-metal coolant and fuel

[a] W. H. Zinn, Nucleonics, vol. 11, no. 11, November, 1953, pp. 30–31; also Reports to the U. S. Atomic Energy Commission on Nuclear Power Reactor Technology, United States Government Printing Office, Washington, D. C., May, 1953.

Type IB(2) is commonly known as the "homogeneous" reactor. A prototype at Oak Ridge has been in operation for almost two years and has been utilized to drive a 150-kw turbine-generator. An "intermediate scale homogeneous reactor" is now being developed. It possesses good features, among which are: The core is a simple aqueous solution of fuel, radiation damage does not limit burnout, fission products can be removed and fuel added continuously, and fission products and plutonium can be removed selectively without handling uranium. The outstanding negative feature is that few materials can withstand the corrosive effect of the circulating fuel for long periods.

Type IC(1) is a pressurized version of the Savannah River production reactors. Supporting technology is advanced and there will soon be operational experience. Both the Bechtel-Pacific Gas and the Commonwealth Edison-Public Service teams have been interested in this type, and now that they have joined forces[1] in the new

A condensation of three papers presented before the ASME Annual Meeting, New York, N. Y., November 29–December 4, 1953, at a session sponsored by the Nuclear Energy Application Committee.

"Status of Nuclear Power Technology," by John W. Landis, The Babcock & Wilcox Company.

"The Problem From an Economic Standpoint," by C. C. Whelchel, Pacific Gas and Electric Company.

"The Legal Situation," by E. Blythe Stason, Dean of the Law School, University of Michigan.

Prepared by S. A. Tucker, Publications Manager, ASME, and member AEC Advisory Committee on Technological Information.

[1] Monsanto is continuing on an individual basis. Union Electric has joined the new Five Company Group, which includes Commonwealth Edison Company and Public Service Company of Northern Illinois (now merged), Bechtel Corporation, Pacific Gas and Electric Company, and American Gas and Electric Service Corporation.

Five Company Group it is reasonable to assume they will continue. Despite the high cost of heavy water, this reactor remains in the running because it can be fueled with natural uranium. There is some doubt, however, as to its long-range usefulness.

Type IC(2), favored by the Bechtel-Pacific Gas group, possesses the advantage of requiring a minimum of heavy water while utilizing its excellent moderating qualities to the maximum possible extent. However, separating the moderator and coolant will introduce complexities which probably will overbalance these advantages.

Type IC(3) uses heavy water as the solvent, with resultant high capital and materials costs. However, there will be sufficient excess neutrons to achieve breeding through conversion of fertile material in a blanket. Again, corrosion is a major problem and actual operating experience is lacking.

Type II A is another breeder. Cast fuel is espoused by Dow Chemical-Detroit Edison; machined fuel by Bechtel-Pacific Gas. Argonne National Laboratory is working on the latter variation. This design possesses the following advantages and disadvantages of most fast reactors:

Advantages

No moderator is used.
High power density per unit volume can be attained.
Can be operated at high temperatures and with high thermal efficiency.
High breeding gain is possible.

Disadvantages

Large fuel investment is required.
Control is relatively difficult.
Choice of coolants is limited.
Neutron flux is high.
Fuel turnover is rapid.

The first fast power reactor probably will be of this type, although much development work remains to be done, particularly in improvement of processing and handling of toxic plutonium. There is a definite possibility, however, that the fuel investment required may restrict the situations to which the reactor may be applied.

Type II B was long considered to be the ultimate objective of reactor development. Here again, however, the large fuel investment required may more than offset, economically speaking, the small amount of fuel consumed by certain high-ratio converters. Also, because the fuel necessarily will be highly concentrated, circulating the fuel outside the reactor probably will prove impractical.

Augmenting the foregoing discussion, Mr. Landis presented his own list of the major problems which face the power-reactor designer today. These have not been arranged in any well-defined order because their importance varies depending on the general type of reactor under discussion.

1 To achieve greater burnout of both natural and enriched fuels, thus reducing the frequency or rate of chemical processing.

2 To reduce the complexity and cost of chemical processing.

3 To reduce or eliminate expensive fuel-element fabrication.

4 To compare carefully the fuel costs of breeders with the fuel costs of converters.

Table 2 Reactor Designs Studied by

Group	Reactor designation	Neutron energy	Fuel
Commonwealth Edison and Public Service of Northern Illinois	HGR Helium-graphite reactor	Thermal	Natural uranium
	PHW Pressurized Heavy water	Thermal	Natural uranium
	PLW Pressurized Light water	Thermal	Slightly enriched uranium
Bechtel and Pacific Gas & Electric	PHLW Pressurized Heavy and light water	Thermal	Natural uranium
	FBR Fast breeder reactor	Fast	Highly enriched uranium
Monsanto and Union Electric	SGR Sodium-graphite reactor	Thermal	Slightly enriched U 0.83% 232 tons
			Slightly enriched U 0.95% 232 tons
			Slightly enriched U 232 tons
Detroit Edison and Dow Chemical	Low melting Alloy fuel Fast breeder	Fast	Highly enriched U or Pu

NOTE: All designs call for plutonium production in addition

5 To eliminate external heat exchange by boiling in the reactor core.

6 To attain high specific power.

7 To reduce corrosion caused by coolants and liquid fuels.

8 To apply supercritical water technology.

9 To design inexpensive leak-proof equipment to handle liquid-metal coolants.

10 To improve methods of breeding, both internal and external.

11 To work out better control devices, especially for fast reactors.

12 To develop materials of construction which do not absorb neutrons parasitically and which can withstand high temperatures and intense and prolonged neutron bombardment.

13 To uncover new useful coolants.

14 To reduce the costs of special materials such as zirconium, beryllium, heavy water, titanium, and so on.

15 To simplify construction generally.

16 To develop methods of handling and disposing of radioactive wastes which will minimize health hazards.

17 To fabricate better shields at lower costs.

Industrial Participation Contractors for Regenerative Dual-Purpose Reactors

Moderator	Coolant	Temperature, deg F In	Temperature, deg F Out	Power, MW Gross heat	Power, MW Net elect.	Cyl. Core Diam, ft	Cyl. Core Hgt, ft	Pressure vessel	Est. cost of plant Total, millions	Est. cost of plant Per kw	Remarks
Graphite	Helium	384	650	350	47	35	20	Sphere 44′ diam 147 psi	$ 40	$850	Short-term development; not promising
Heavy water	Heavy water	388	440	1064	211			Sphere 20′ diam 800 psi	118	560	Short-term development; heavy water at $80 per lb
Light water	Light water	369	440	1243	246			Cylinder 12′ d. 39′ Hi. 800 psi	73	297	Short-term development
Heavy water	Light water	384	500	500	101	13	11	Not designed	41	405	Short-term development; heavy water assumed to cost $80 per lb
None	Sodium	600	900	500	145	3	3	Not required	51	350	Long-term development; considerable development needed
		300	605	1000	210	35 (octagonal)	20 (prism)		100	476	Medium-term development; some development of liquid metal technology needed
Graphite	Sodium	300	900	3000	554			Not required	156	282	
		300	825	675	125	16 (octagonal)	15 (prism)		60	480	
None	Sodium	400	1000	600	200	3	3	Not required	Not yet estimated		Long-term development; advanced design

to electric power. Uranium 238 is the fertile material for all.

Economic Aspects of Nuclear Power Plants

Turning from the more technical aspects, Mr. Whelchel defined the economics of nuclear power as divided into two broad areas: (1) That based on present knowledge of the art, and (2) the later phase when and as nuclear power becomes competitive with power produced by conventional steam stations. Present studies, including assumptions that have to be made for lack of knowledge, indicate that power produced from initial large-scale single-purpose reactors will cost more than steam power from fuel-fired plants. This may not correctly represent the second phase for plants designed and built in the future.

There is need for a new and extensive fuel supply. Demand for electric power has been increasing at a rate equivalent to doubling every ten years. To produce twice or four times present output will require vast amounts of fossil fuels. Estimates of the world supply of recoverable uranium vary, but they exceed by a number of times the world's fossil-fuel supply if, by breeding, all the uranium can be used. It seems prudent to take the necessary steps, including construction and operation of full-size plants, to determine the role that atomic power may take.

Table 3 presents an economic comparison of costs associated with a modern conventional steam plant and corresponding costs that must be realized if nuclear plants are to break even with steam. It is generally accepted that capital costs of economic nuclear power will remain higher than for conventional plants and that the fuel costs must then be lower. Arbitrary nuclear-fuel costs have been taken at one-half fossil-fuel costs for Plant A and at zero for Plant B.

The zero fuel cost reflects a limiting condition and is not altogether unrealistic. The possibility of fluid fuels eliminating fuel-element fabrication and simplifying chemical processing, of increased "burnup," of high conversion factors, and of the by-products having some value all extend the hope of low-cost fuel. Operating, maintenance, and general expense have been taken at 40 per cent greater than for the conventional plant because of the inherent radiation problems of the reactor system.

These studies indicate that it is possible to pay some 100 to 200 per cent more for the reactor and heat-exchanger steam-producing facilities than for conventional boilers and still break even on over-all power cost. Thus nuclear plants can compete even at higher first

cost if fuel costs are low enough and capacity factor is high. High capital cost is not new to utility financing; the capital cost of hydro projects is often more than twice that of steam plants.

This comparison has been based on the assumption that life and reliability of nuclear plants are equal to that of conventional plants. However, cost, life, operating, and maintenance characteristics of conventional plants are known from long and continuing experience; there is lack of such experience with the nuclear plant.

Today's estimates of capital costs for nuclear power plants vary greatly, but are in agreement to the extent that they are all high. Estimates range from $350 to $900 per kw for large plants. To be competitive, even under conditions of favorable nuclear-fuel costs, capital investment must be lowered to something like $200 to $300 per kw.

Legal Problems of Nuclear Power Plants

Not only technical and economic problems confront the would-be nuclear power-plant operator, there are plenty of new legal problems unique to the attempt, according to Dean Stason. The scene literally bristles with them. Just as the scientist, engineer, and business executive are gradually resolving the technical and economic difficulties, the legal profession must see to it that no barrier remains to the development of this new form of energy for the benefit of mankind.

Until the Atomic Energy Act of 1946 is amended in certain very substantial particulars there simply will be no privately financed nuclear electric power. Section 4 expressly prohibits private ownership of facilities for the production of fissionable materials, such as would be needed for any breeder reactor. Section 5 contains provisions which will make it exceedingly difficult for a private facility to get nuclear fuels; even possession by private persons by way of loan or lease is absolutely prohibited.

Section 7 prohibits private persons from utilizing fissionable materials unless licensed by the Atomic Energy Commission, an agreement which may be terminated by the AEC at any time, without notice or opportunity for hearing. Note that the legal right of continuity in business will be important to the nuclear-power industry.

Private patents in the normal American sense are not permitted. The normal encouragement given by the patent system is withheld. Without such encouragement there certainly will be a substantial drag upon research and development.

Certain other federal laws affect the nuclear-power operator. If there is likelihood of pollution of navigable streams by discharge of radioactive substances clearance must be obtained from the U. S. Surgeon General. If the potentially polluted stream forms a state boundary, there are some applicable interstate compacts.

Perhaps a more important and certainly more difficult problem arises under the federal antitrust laws. The nuclear power plant is destined to be a far more complex organization than the existing type of steam plant, having activities connected with a multitude of chemicals, waste products, isotopes, and perhaps other end products, all of which must be disposed of to the greatest possible advantage if the business is to be economically successful.

Table 3 Cost Comparison of Competitive Conventional Steam and Nuclear Power

	Conventional steam plant	Nuclear plants	
		Plant A	Plant B
Fuel cost:			
Mills per kwhr	2.6	1.3	0.0
Annual cost per kw:			
Total annual cost[a]	$ 43.40	$ 43.40	$ 43.40
Fuel for 0.75 capacity factor	17.10	8.55	0.00
Capacity cost	$ 26.30	$ 34.85	$ 43.40
O&M and general expense	$ 5.00	$ 7.00	$ 7.00
No load fuel	2.60	1.30	0.00
Fixed charges (12.5 per cent)	18.70	26.55	36.40
Capital cost per kw:			
Total cost	$150.00	$212.00	$291.00
Electric facilities	80.00	80.00	80.00
Steam-producing facilities	$ 70.00	$132.00	$211.00
Power cost in mills per kwhr:			
0.75 capacity factor	6.6	6.6	6.6
0.60 capacity factor	7.6	7.9	8.2
0.90 capacity factor	5.9	5.7	5.5

[a] To make the nuclear plants competitive their annual costs are made the same as that of the reference conventional plant.

Furthermore, the relations with the Federal Public Utility Holding Company Act must be reviewed as well as reports that may have to be made to the Federal Securities and Exchange Commission. Each detail of the legal problem must be given careful consideration in anything like the initiation of even the early nuclear-power enterprises.

Each nuclear-power enterprise must, of course, obtain a certificate of convenience and necessity from the state public-utility commission. Nuclear-power projects will present some new and unusual questions. At the outset at least, such certificates will not be issued as a matter of course and proper proofs as to power costs, likelihood of power failure, and so forth, will be required.

Nuclear-power projects are also likely to meet unusual problems in approval of security issues, acquisition of stock, approval of intercompany contracts, rate regulation, and other procedures necessary to the complex character of the new industry. Safety regulations, especially those pertaining to injury to employees from radioactive materials, are already stringent and may become more so in the years to come. Special problems in connection with insurance coverage and liability are in prospect.

Finally, at the local level, certain county rural zoning acts and township building regulations are to be encountered. Undoubtedly the nuclear reactor with its potentialities for harm to persons and property will be looked on with local disfavor by county and township zoning authorities, at least in the more populous areas.

Despite this apparently insurmountable complex of technical, economic, and legal hazards, the possibilities of producing dependable power from pounds of fuel instead of hundreds of tons, the practicability of utilizing all the energy locked in uranium and thorium by breeding, and the resulting benefit to mankind in the future from nuclear by-products, is held to be well worth the considerable effort necessary to remove the legal obstacles now standing in the way of progress.

Table 1 Condensed Key to ASTM System for Specifying Cellular-Rubber Compounds

Example: SC-12-CR	Prefix	SC	Indicates synthetic rubber compound having medium oil resistance.
	Numeral	12	Indicates it is open cell sponge and can be compressed 25% by load of 7±2 psi.
	Suffix	C	Indicates it will pass a special weathering test set up by manufacturer and purchaser.
	Suffix	R	Indicates it meets certain resilience requirements as measured by ASTM D945.

Oil Resistance: Designated by Prefix Letters

Designation

R ..... For application where specific resistance to petroleum oils is *not* required. May be a compound of natural, synthetic or reclaim rubber or combination thereof.

SB ..... For applications requiring *low* (2) volume swell in petroleum oils. Must be a compound of synthetic rubber(s).

SC ..... For applications requiring *medium* (2) volume swell in petroleum oils. Must be a compound of synthetic rubber(s).

Special Requirements: Designated by Suffix Letters

Designation	Test Required	ASTM Test Procedure	Designation	Test Required	ASTM Test Procedure
A	Oven aging	D573	J	Abrasion	(5)
B	Compression set	D395	K	Adhesion	D429
C	Weather resistance	(5)	L	Water absorption	(5)
D	Special load deflection	D1056	M	Flame resistance	(5)
E	Oil aging	D471	N	Impact	(5)
F	Low temp. (—40)	(5)	P	Staining	D925
FF	Low temp. (—70)	(5)	R	Resilience	D945
G	Tear resistance	D624	Z	Performance or special test	(5)
H	Flexing	(5)			

(1) Full discussion of the ASTM system and description of the test methods may be found in "ASTM Standards on Rubber Products," American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. Price $3.75 to members, $5 to non-members. (2) As measured by ASTM D-471. (3) See ASTM D1056-52T. (4) See ASTM D1055-52T. (5) Test to be arranged between manufacturer and purchaser.

Cell Structure and Firmness: Designated by Middle Numerals

	Designation	Compression. Lb. to Compress 1 Sq. In. 25% (3)
Open Cell Sponge Rubber	10	1 +1—½
	11	3½ ± 1½
	12	7 ± 2
	13	11 ± 2
	14	15 ± 2
	15	20½ ± 3½
Closed Cell Expanded Rubber	41	3½ ± 1½
	42	7 ± 2
	43	11 ± 2
	44	15 ± 2
	45	20½ ± 3½

	Designation	Indentation. Lb. to Compress 50 Sq. In. 25% (4)
Latex Foam (Cored)	21	9½ ± 3½
	22	17½ ± 4½
	23	28½ ± 6
	24	42½ ± 7½
	25	58½ ± 8½
	26	76½ ± 9½
	27	96½ ± 10½
	28	118½ ± 11½
Latex Foam (Uncored)	31	7½ ± 2½
	32	17½ ± 7½
	33	32½ ± 7½
	34	50 ± 10
	35	72½ ± 12½

Cellular Rubber Shows Versatility as an Engineering Material

Soft as a powder puff or hard as oak, the uses of cellular rubber range from shoe soles to head rests and from soft gaskets to hard life rafts which keep their buoyancy indefinitely.

By G. R. Sprague and A. F. Sereque[1]

CELLULAR rubber is made in an infinite variety of molded and die-cut shapes, flat sheets, rods, and tubes in almost any wanted degree of firmness, with either open (interconnecting) or closed (noninterconnecting) cells. It can be made to resist high or low temperatures, oil, water, and flame. It can be bonded in manufacture to fabrics of almost all types, including linoleum and paper, and can be furnished with a coating of dry cement which can be easily reactivated by the consumer.

There are four types of cellular rubber, three of which are defined by the ASTM:

1 Sponge rubber, which is chemically blown, has open cells and is made from dry rubber.

2 Foam rubber, made from latex, also with open or interconnecting cells.

3 Expanded rubber, which is made from dry rubber and has closed cells.

4 Ebonite, or hard, cellular rubber.

The ASTM has devised a simple system for identifying these grades (except ebonite) consisting of prefix letters, numbers, and suffix letters. Prefix R stands for rubber, either natural, reclaimed, or synthetic, where oil resistance is not required (formerly RN for natural rubber and RS for synthetic). SB identifies maximum oil resistance and SC, medium oil resistance. These letters are followed by two-digit numbers.

The first digit which follows the prefix letters gives the type; i.e., 1 stands for sponge rubber, 2 for cored foam, 3 for uncored foam, and 4 for expanded rubber.

The second digit gives the degree of firmness and the suffix letters indicate special requirements, such as flame resistance, low-temperature resistance, and so forth. A condensed key for specifying cellular rubber is given in Table 1.

[1] Director of Research, Director of Testing Laboratory, respectively, of The Sponge Rubber Products Company, Shelton, Conn.

Contributed by the Rubber and Plastics Division and presented at the Annual Meeting, New York, N. Y., November 29–December 4, 1953, of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

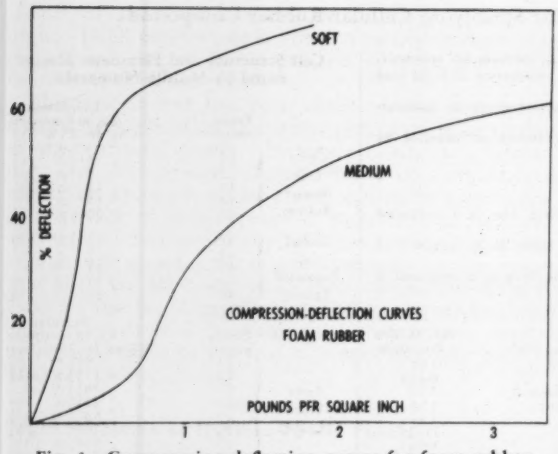


Fig. 1 Compression-deflection curves for foam rubber

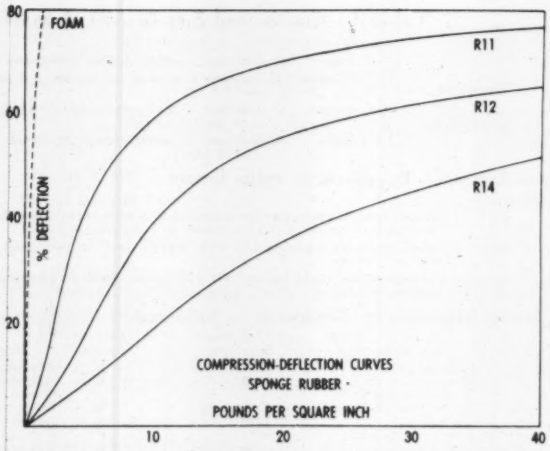


Fig. 2 Compression-deflection curves for sponge rubber

Sponge Rubber

The most important property of sponge rubber is its ability to be compressed without causing distortion in other directions, and its ability to recover its original shape. The range of compressibility is great and is defined by the ASTM as the force, expressed in pounds per square inch, required to compress the material 25 per cent. The softest material is latex foam, from which pillows, mattresses, seat cushions, and other shock-absorbing devices are made. The 25 per cent compression figure on this material can be as low as 0.10 to 0.15 psi.

At the other extreme is ASTM Class 15 sponge, which requires 17 to 24 psi for 25 per cent deflection. Although this is the firmest sponge given an ASTM rating, much firmer ones can be manufactured if needed. One example is the new, expanded-rubber shoe sole, which has a compression of about 40 psi. Thus the compressibility of a very firm stock is 400 times that of a very soft grade. Figs. 1 and 2 give the complete compression-deflection curves for a soft and medium foam, and a soft, medium, and firm sponge. Note, in Fig. 2, that the force on the sponge rubber goes to 40 psi, and in Fig. 1, that the force on the foam rubber goes only to 3 psi. The dotted line on the extreme left of Fig. 2 shows the extreme softness of a soft foam rubber as compared to sponge rubber.

Another important property connected with compression is the fact that sponge rubber gets firmer as it is compressed, as shown by the compression-deflection curves in Fig. 1. This gives a unique cushioning action, soft at initial impact and gradually offering more resistance to compression, thus preventing "bottoming" or bumping when a load is applied. This property accounts for the success of sponge rubber of the type shown in Fig. 3, as crash padding on automobile dashboards.

The next most important characteristic of sponge rubber is its ability to recover after compression. Even 500,000 compressions to 50 per cent cause a loss in height of but about 5 per cent and a loss in firmness of no more than 10 per cent for foam and 25 per cent for firmer sponge. Sponge rubber is, therefore, used in electric vibrators or as gaskets in automobile doors. When compressed to 50 per cent and held in that position for 48 hrs, loss in height is less than 5 per cent and less than 25 per cent after 4 years. Thus sponge rubber is an excellent material for gaskets and seals of all types, including washing-machine doors, cowl vents, and automobile trunks, Fig. 4. For many of these, a skin of mechanical rubber is applied to add extra abrasion resistance and water resistance. By the use of different synthetics, these parts may be used in contact with aromatic or aliphatic oils and solvents, at temperatures ranging from —90 F to 600 F.

Imparting Special Properties to Sponge Rubber

Many properties may be imparted to sponge rubber by choice of polymer, natural rubber or synthetic, and by special compounding. Tensile strength, which, in general, is a function of the density for the same compound and elongation, may be increased or decreased by choice of compounding ingredients. Oil resistance, often the most important factor in many applications, depends on the polymer. Natural rubber has poor oil resistance. Neoprene is excellent to aliphatic oils (kerosene, gasoline, fuel oil) and the Buna N or nitrile rubbers are excellent against aromatics (toluene, xylene, benzene, aviation gasoline). Flame resistance is acquired by the use of neoprene with special compounding ingredients. Other properties that may be engineered into the compound are ozone and weather resistance, resistance to water, nonstaining to lacquer, and resistance to high and low temperatures. Rubber is naturally fungus and vermin-resistant and under most conditions needs no additional protective ingredients.

Usually one or more of these properties are necessary for proper application. Automotive gaskets must have the correct firmness, have an applied skin to be resistant to abrasion and weathering, be nonstaining to lacquer, and have good cementing qualities. Reflector gaskets must not cause tarnishing and must have low water absorption. Gaskets for blood containers must contain no toxic or harmful ingredients.

Iron-lung gaskets, Fig. 5, combine several necessary qualities found in no other material. These circular

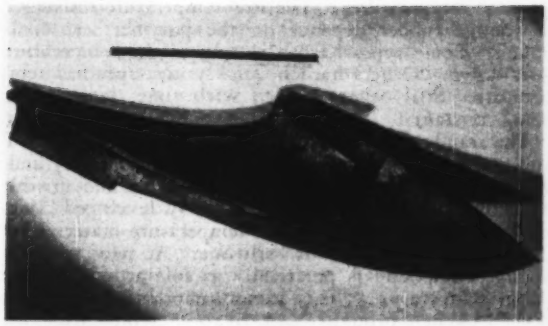


Fig. 3 Molded cellular-rubber crash-pad component for use in automobile dash boards

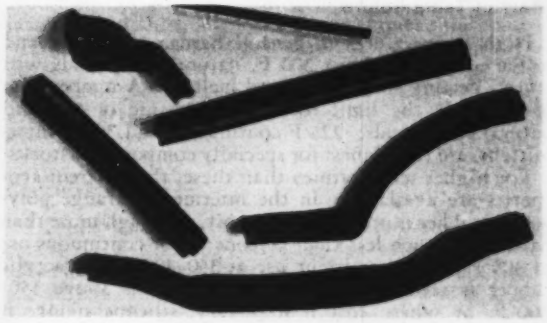


Fig. 4 Molded cellular-rubber weatherstripping and seals for vehicle doors, trunks, and hatches

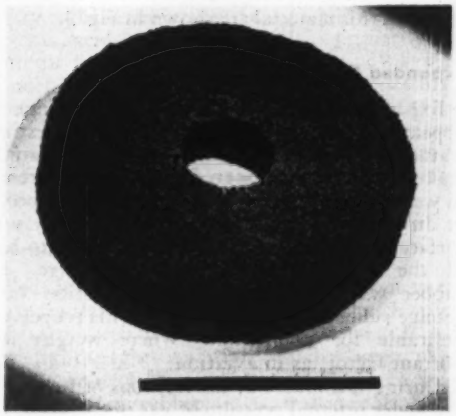


Fig. 5 Cellular rubber iron-lung accessory material

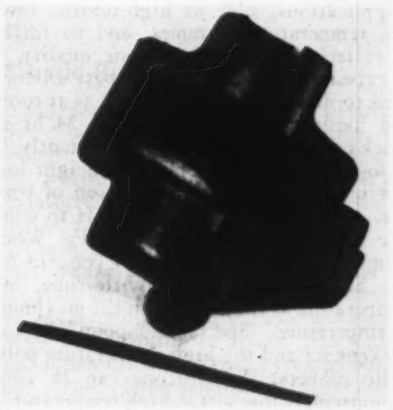


Fig. 6 Cellular rubber insulating and condensating inhibiting valve cover

gaskets have a 2-in-diam hole in the center. The stock must have enough tensile strength and elongation so that a man can put his head through the hole without tearing the sponge. It must have a low modulus of elasticity so that it will cling firmly to the patient's neck, yet cause no discomfort or interfere with breathing. Because the stock is split in half and the skins cemented together, it is impermeable enough to air so that the pressure within the iron lung can be kept up. And, it must contain nothing that would irritate the skin after prolonged contact.

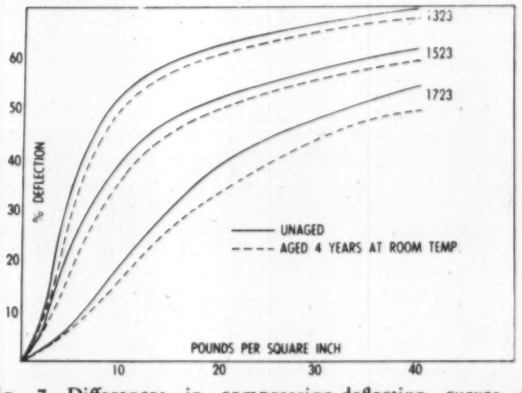


Fig. 7 Differences in compression-deflection curves of samples of sponge rubber aged 4 years at room temperature

Much sponge-rubber tubing is used to cover water pipes in air-conditioning systems. Because it can be made in the same inside diameter as the pipes and is soft and flexible, it can be slid over pipes or copper tubing and follow the curves and bends easily. Because of its natural insulation value, it keeps the pipes from sweating. In severe climates it can be given a mechanical skin to make it impervious to moisture. More complicated shapes may be covered with a molded part, such as the valve cover shown in Fig. 6.

The greatest enemies of sponge rubber are ozone and heat. When protected from these, sponge has extremely long life. Samples stored over 20 years are in excellent condition. Fig. 7 shows the very slight difference in compression-deflection curves of samples aged 4 years at room temperature. Likewise, samples compressed to 50 per cent for 4 years showed a recovery of 75 per cent of their original height. Thus gaskets will keep their sealing ability for years.

Effect of Temperature

High temperatures in general harden synthetics and soften natural. Above 300 F, natural compounds will revert, getting soft, tacky, and melted. A temperature of 175 F is the limit for continuous use of standard natural compounds; 225 F continuous, and 300 F intermittent, are the highest for specially compounded stocks.

For higher temperatures than these, the different synthetics are available. In the intermediate range polyacrylic rubber is preferred as its cost, although more than natural, is much less than silicone. For continuous use at 300 F and intermittent use at 350–400 F, polyacrylic rubber is recommended. For applications above 350–400 F, or where cost is secondary, silicone sponge is mandatory.

Silicone sponge combines the thermal stability of the silicones with the elasticity of rubber. Silicone sponge rubber, like other sponge rubber, can be custom-made for particular applications, such as high-tensile, low-compression set, temperature extremes, and so forth. As with most materials, emphasizing one quality is usually at the expense of another. The best silicone sponge developed to date is as soft at —90 F as at room temperature and hardens only slightly after 24 hr at 550 F. This stock can be used to 600 F intermittently.

The compression set, that is, the per cent height lost after being kept in compression, is a function of time and temperature. The standard ASTM test is to compress the sample 50 per cent for 22 hr at 158 F. When done in this manner, the sets are but a few per cent for natural rubber. Sets increase slowly with time, but rapidly with temperature as they approach the maximum recommended temperature. Special compounding can decrease the per cent set and the high-temperature polymers, polyacrylic rubbers, and silicone can be compounded to give extremely low sets at high temperatures.

High temperature affects the other properties of sponge rubber about as could be expected. The rubber stiffens and gets hard; tensile increases and elongation decreases to a certain point; then deterioration sets in.

Low-temperature characteristics are of utmost importance in military, aircraft, and other applications. The ideal sponge rubber would not harden at low or elevated temperatures. The low-temperature resistance of sponge rubber depends on the polymer and compound. Some types harden slowly as the temperature goes down. Others harden quickly at a specified temperature. Still others harden with time, temperature being constant.

The standard synthetics will stay fairly soft to —20 F and harden at —40 F. Natural rubber is better and, when specially compounded, will be soft and flexible at —70 F. So, also, will be the newly developed "Arctic" polymers. The best low-temperature material yet developed, however, is silicone. A new silicone sponge compound is practically as soft at —90 F as at room temperature. This same compound is good to 600 F. When brought back to room temperature the sponge retains all its original properties. Likewise, when compressed at low temperature and held in this position, the sponge will return to normal size when brought to room temperature. Compression-deflection curves of this material are shown in Fig. 8.

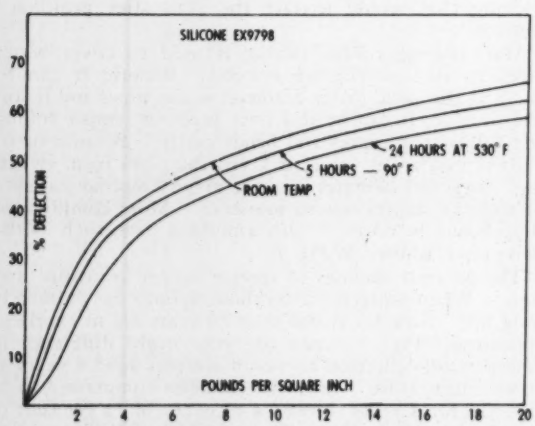


Fig. 8 Effects of temperature on compression-deflection curves of silicone sponge compound

Expanded Rubber

Expanded rubber is quite similar to sponge rubber in appearance and feel, but has several distinguishing features. Its noninterconnecting, nitrogen-filled cells make it permanently waterproof. It is extremely light in weight, is verminproof, and does not absorb moisture or dirt. It can be cleaned easily merely by wiping the surface and can be made oil-resistant and to have many of the special characteristics of sponge. Expanded rubber will have the same compression values as a sponge rubber twice its density. This property makes it desirable for applications where weight is an important factor, as in aviation.

During manufacture, the millions of tiny, closed cells are under internal pressure of gas in each cell. This gas diffuses through the cell walls, resulting in shrinkage. Most of this occurs in the first few days, and, therefore, material to be die-cut should be aged from 2 to 4 weeks before cutting. Recently, a new process in manufacture has minimized this problem greatly. For the same reason, use of expanded rubber at high temperature or under severe compression is not recommended.

Expanded rubber is an excellent insulation and buoyancy medium. It is used for gaskets on wings and hulls of seaplanes and as water or oil-resistant seals. It makes a good vapor barrier and is an excellent seal at lower pressures than open-cell sponge requires. It has high abrasion resistance and is used for shoe soles. These soles are firm and long wearing, but still extremely light.

Cellular Ebonite Offers Advantages

Cellular ebonite is made practically only in expanded form. A rigid, firm, extremely light material, it resembles charcoal in appearance. It has an extremely high structural strength-to-weight ratio and is reputed to be one of the strongest materials for its weight in commercial manufacture. Density may be as low as 5 lb per cu ft with a structural strength of 25 psi, and strength increases rapidly to several hundred psi for 15 to 20 lb density. It is to some extent thermoplastic and sheets can be postformed by heating and shaping. It can be made resistant to oils, acids, and temperatures to 290 F. It will not disintegrate, crumble, or become water-

logged and, except for physical damage, will last indefinitely. Its most important uses are for flotation and insulation. Millions of disks have been used to form life rafts and mine-sweep floats. Its light density makes it extremely buoyant. Its resistance to water retains this buoyancy indefinitely. Unlike inflatable floats, it loses little of its buoyancy when punctured, and its strength enables it to withstand abuse. Its resistance to solvents and strong acids permits its use in chemical tanks where other materials would decompose. One important use is as a carburetor float in units burning either regular or aviation gasoline.

As insulation, it is of the best, having a K-factor of 0.20 to 0.25. Sheets are used as a space filler between the inner and outer hulls of boats where it acts as an insulation medium while also fulfilling its major task of filling the empty space with a nonabsorbent material which will add buoyancy in case of damage.

When compounded with thermosetting resins, a very hard, lightweight material results, which is inert to oils, most solvents, acids, and so forth. It is primarily used for carburetor floats in aircraft and tanks. When immersed under 30 psi pressure in a test fluid consisting of 40 per cent aromatics and 60 per cent di-isobutylene, the weight gain after 72 hr is but a few milligrams. This material also can stand high temperatures and has been tested for 120 hr at 200 F and 18 hr at 350 F with no cracking or swelling.

Polyvinylchloride

Expanded polyvinylchloride is a relatively new material quite similar to expanded rubber, but with special properties characteristic of the base material. It is an extremely lightweight material, usually with closed cells, and can be made in densities of 3 lb per cu ft and up. Like expanded rubber, it is waterproof, highly buoyant, and has high insulation value. It can be made fire-resistant and is resistant to many chemicals such as oils, gasoline, acids, and alkalis. Its resistance to sunlight and ozone is exceptional. Its elasticity is less than rubber and it has a high energy-absorption value.

One important use of the firm material, combining many properties, is for an airplane ejector-seat base, Fig. 9. This is a large structural member on which the seat cushion is placed. Its extraordinary low density makes it especially advantageous for airplane use. Its strength easily supports weight and its ability to absorb energy keeps it from shattering or breaking when it is given a sudden impact to throw it out of the cockpit.

The medium grade of polyvinylchloride is used for fish floats for commercial fishermen. Because of their weathering resistance, their life is almost limitless. The soft grade is used for cushioning, where its energy absorption is of value.

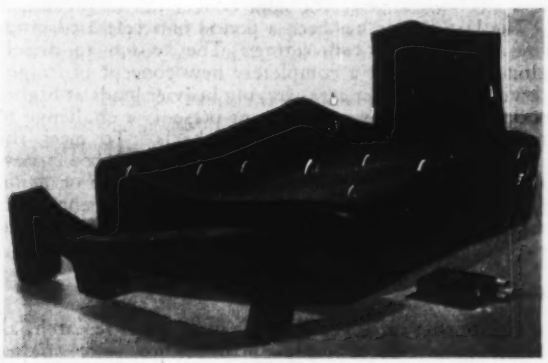


Fig. 9 Airplane ejector-seat base made of polyvinylchloride

Conclusion

Cellular rubber, with its many combinations of properties, is a versatile material for engineers. When specifying cellular rubber, it is best to examine closely the ASTM tables and order by their numbers and suffix letters. If the properties required are not there, consult with the manufacturer who quite often can adapt a compound to fit particular needs.

• • •

Plastic-Pipe Research

METHODS for the evaluation of plastic pipe were established in an extensive engineering research program which commenced December 1, 1953, at Battelle Memorial Institute, Columbus, Ohio. This program is being sponsored by 29 companies in The Society of the Plastics Industry, Inc.

These companies are extruders of various types of plastic pipe and suppliers of the raw materials. This program will develop effective test methods on such factors as bursting strengths, safe working pressures, long-range serviceability of plastic pipe under static pressure and dynamic loading, such as occurs with water hammers and reciprocating pumps.

Because of the increasing demand for plastic pipe since it first appeared on the market 12 years ago, the number of installations has grown tremendously. Plastic-pipe sales for 1953 were expected to exceed $15,000,000 compared to a $500,000 market in 1948.

Various types of raw materials presently are being used in plastic-pipe applications for the transmission of water in potable water supply systems; natural gas; oil; mine drainage; chemicals and beverages. It is also being used extensively in varied irrigational installations. While these installations, which, in some cases, constitute field tests, have proved satisfactory, the plastic-pipe manufacturers recognize that reliable test methods and engineering data must be developed. Materials from which Battelle will evaluate test methods for plastic pipe are cellulose acetate butyrate, polyethylene, polystyrene, and polyvinyl chloride.

The development of these test methods for the evaluation of plastic pipe is but one constructive step in the program of plastic-pipe manufacturers to assure a quality product. At the present time they also are developing standards which it is planned will be issued through the Commodity Standards Division of the United States Department of Commerce, as voluntary industry standards on dimensional weights, sizes, and performance specifications for various types of plastic pipe.

A Steering Committee comprising pipe extruders and material suppliers is co-operating with the Battelle Laboratories in the development of these test procedures which it is believed will take a period of approximately two years.

Fig. 1 Steps in preparation of three-riser holes

Fig. 2 Spraying drag side of mold with silica wash

Pressure-Pouring Steel Car Wheels

New Process Involves Permanent Molds Machined From Graphite

By E. Q. Sylvester

Executive Vice-President, Griffin Wheel Company, Chicago, Ill.

For more than 75 years the author's company has been designing, developing, and producing car wheels for railroad equipment. This period has witnessed a continued search for improved design, increased strength, and longer wheel life. Also during this time more than 48 million car wheels have been produced for the railroads of the world, enough to rewheel every freight car in the United States three times.

The railroad-car wheel, in particular, is subjected to more abuse than any other component part of a freight car. It is continually subjected to excessive stresses in its primary purpose of carrying a load at any and all speeds. Heavy loads are carried on the small area of contact between the wheel and the rail causing high repetitive stresses as the wheel revolves. The wheel also is subjected to high thermal absorption. These two functions of the wheel make up its dual service of carrying the load and stopping the train. In spite of this severe treatment, an analysis of ICC derailments indicates that car wheels are responsible for less than 8 per cent of the total.

Economically, the wheel has been one of the most reasonable products purchased by the railroads, one reason being that it may be purchased on a conversion or exchange arrangement which reduces the cash outlay for replacement wheels and provides an insured outlet for all scrap wheels. It serves equally well for the manufacturer in that it eliminates the necessity of shopping for metal and, therefore, the fluctuations of the scrap market are not of paramount importance in wheel prices. It is the desire of the industry to market its new steel wheel with the same conversion arrangement.

The last decade has been a period of accelerated progress in American railroading. The switch to diesels alone has brought a completely new concept of freight service with heavier cars carrying heavier loads at higher train speeds. This new concept presents a challenge to the performance of freight-car wheels. To meet the challenge the author's company has developed a new steel wheel. The wheel and its unique method of manufacture, involving pressure pouring and permanent molds machined from graphite, constitute the subject of this paper.

Graphite Molds

During the early years of our new wheel research, all known methods of wheel manufacture were studied and evaluated and it was realized that none was satis-

Contributed by the Railroad Division and presented at a joint session of the Railroad Division, Research Committee on Metal Processing, and the American Society for Testing Materials at the Annual Meeting, New York, N. Y., November 29-December 4, 1953, of The American Society of Mechanical Engineers.

factory and that a new process had to be developed. A conventional cast-steel wheel made in a sand mold already had been produced but had to be abandoned for economic reasons. Complete information was available on this wheel and it was evident that a large portion of the cost was incurred in the cleaning room correcting foundry defects. It was thought that, if possible, complete elimination of sand in the mold would be helpful in overcoming some of the previous troubles.

The development of the graphite-mold wheel was for the most part a matter of trial and error. Actually, five different types of wheels were studied, tested, and discarded for various reasons. A wheel cast in a graphite mold eventually emerged after 10 years of research in endeavoring to make a wheel which would be equal, or superior, to any wheel on the market and which could be produced at a cost attractive to both the consumer and the producer.

Graphite is one of the few materials which has adequate thermal-shock resistance to withstand the action of molten steel without cracking. Graphite also lends itself as a mold material because of its low coefficient of expansion and its resistance to distortion even when subjected to excessive thermal gradients. Graphite is readily machined and will not oxidize when it is kept at a temperature below 800 F. Decarburization of castings is kept to a minimum in a graphite mold. To produce perfect castings, the density and permeability of graphite must be closely controlled. This is done by controlling the particle size and graduation of the raw mix. Because it takes 6 months to process graphite, long delays were encountered in waiting for new types of graphite for molds. High-density graphite causes blowholes and poor surface appearance, while low-density high-permeability graphite permits metal penetration, erosion, and spalling. A permeability-evaluation test has been developed which can be used to check the degree of permeability of the mold stock and definite limits have been established for a good mold material.

As in all materials, there are some properties which are not satisfactory. These properties were such that extensive steps were necessary in the process to circumvent these weaknesses. The life of the wheel mold had to be considered because to be competitive the mold had to last for many pourings. Graphite has a very poor resistance to metal erosion and will not withstand mechanical abuse. The graphite-mold method would not be a success without a satisfactory method of pouring. Mechanical abuse had to be overcome by designing mold-handling equipment properly. Graphite is a porous material and it will absorb moisture readily. We have found that it is necessary to keep wheel molds at a temperature of about 200 F to prevent moisture absorption. A damp mold will cause boiling during the pour and subsequent bad wheel appearance. The life of graphite molds is not known at this writing but at the present time we believe we can machine molds, which are 42 in. diam and 18 in. thick, as many as 20

Table 1 Properties of Molar Graphite

Apparent density, gm/cm³	1.63
Per cent porosity	27
Electrical resistivity, ohm-in.	0.00038
AFS permeability (air), ml/cm²/cm/min/1 gram pressure difference	1.0
Modulus of rupture	1700 to 2200 psi
Chemical analysis, per cent:	
Total ash	0.4
Sulphur	0.05
Graphitic carbon	99.5
Thermal conductivity, Btu/hr/°F/ft²/ft	85
Specific heat, (avg 100-800 F)	0.25

Fig. 3 Assembling molds on conveyer

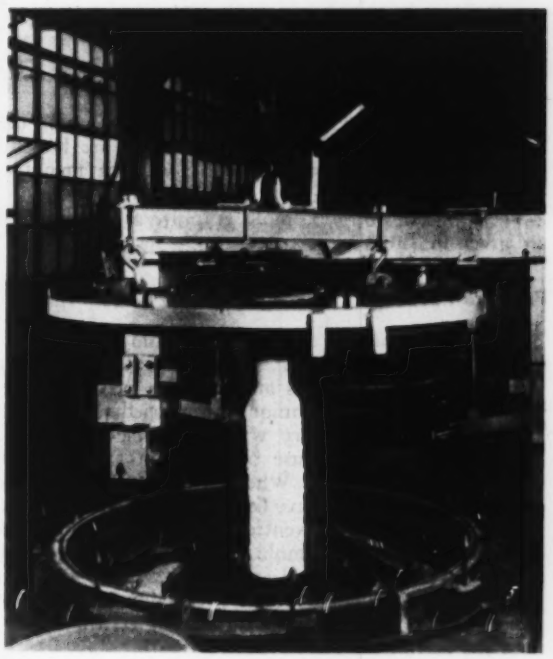


Fig. 4 Pressure tank, cover, and pouring spout

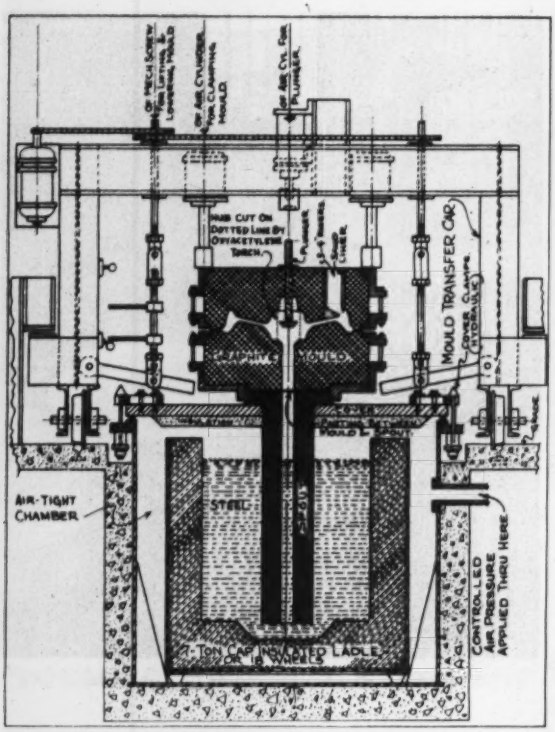


Fig. 5 Schematic drawing of pouring arrangement

times. To date we have poured 400 wheels in a mold without machining.

The graphite blocks produced for this project are the largest that ever have been made and we are hopeful that even larger blocks eventually will be manufactured.

The properties of good mold graphite as standardized are given in Table 1.

Pressure Pouring

The proper pouring of a graphite-mold wheel is the key to the whole process. Initially, gravity pouring was tried and in all cases mold erosion was excessive. Various schemes and techniques were tried to no avail. To produce a satisfactory wheel, the metal must be introduced rapidly because of the high thermal conductivity of the molds. Wheels which are poured too slowly are usually defective because of cold shots, scabs, and wrinkles. In a conventional gravity-pouring process, fast pouring causes mold erosion and splatter with cold shots and poor wheel appearance. Many castings are ruined in pouring. Actually, we did not realize how great an effect control pouring can have on the appearance and performance of a wheel.

Vacuum pouring, or sucking the metal up into the mold through a tube, was tried first after other methods failed. While vacuum pouring was better than gravity pouring, leaks were encountered and the height to which the metal could be raised was limited to approximately 50 in.

Pressure pouring, which is forcing metal up into a tube and into the mold cavity by air pressure, finally

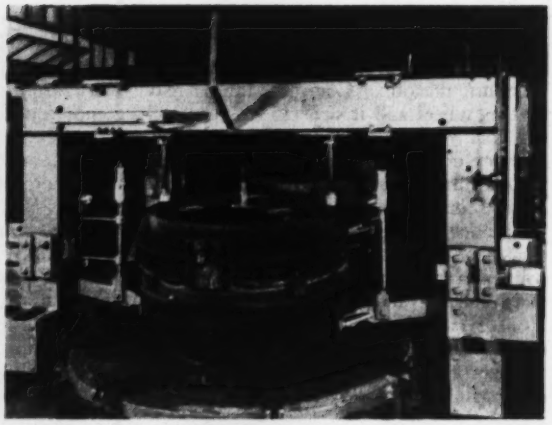


Fig. 6 Mold in pouring position

was accepted. The height to which the metal may be raised is controlled by the pressure. One pound per square inch will raise steel approximately $3\frac{1}{4}$ in. The rate of pouring is controlled by the inside diameter of the pouring tube and the rate of pressure built up. In practice, pressure pouring is accomplished by placing a ladle in a steel tank submerged in the floor. A cover with a pouring spout attached is lowered over the tank and clamped to it. The spout reaches to within about 2 in. of the bottom of the ladle. The slag, of course, is removed from the surface of the steel before the tube is plunged down into the ladle. A mold is then positioned and clamped over the top of the pouring tube. Controlled dry compressed air is introduced into the tank, which forces the metal up the tube into the mold cavity.

After the mold is filled, a stopper is forced down through the molten steel, shutting off the flow. The air in the tank is exhausted to atmosphere which permits the metal under the stopper to drain back down the tube into the ladle. The filled mold is then moved off and a new one brought into position and the process repeated.

In our opinion, pressure pouring is the only method yet developed to control the pouring of steel at all times. Our process is electrically controlled and the pressure built up is under a program controller. The pouring rate does not vary with the amount of metal in the ladle, as in the case of bottom-pouring ladles, and it eliminates the necessity of ladle stoppers and seats.

In order to prevent washing of the mold, the metal entering the mold should not spurt or "geyser." Although an exact solution of this problem would be quite involved, elementary theory indicates limiting values. From elementary theory, the velocity of the metal entering a mold from a top gate will be

$$V = \sqrt{2gh}$$

where

V = velocity of metal, ips
g = acceleration of gravity = 386 ips
h = effective height of metal column

In order to prevent eroding the top of the mold, the entering velocity of the metal should be less than the value computed by the foregoing formula with h being the distance from the top of the mold to the point where the

tube enters the mold at the bottom. If the distance is 12 in., then the value of V will be

$$V = \sqrt{2 \times 386 \times 12} = 96 \text{ ips}$$

Since a cubic inch of molten steel weighs about 0.27 lb, the effective height of 12 in. will be equivalent to a pressure of $3^1/_4$ psi of air above that required to maintain the static height of the steel in the mold.

Our pouring rate is estimated to be in the neighborhood of 150 lb per sec and the mold is filled in approximately 5 to 6 sec. This is well below the geyser stage.

A problem which has not been solved completely is the pouring tube. This tube is composed of clay graphite sleeves cemented into a seamless-steel tube. The outside of the steel tube is protected with a high-temperature castable cement. We are able to pour 4 to 5 heats per tube, which we do not consider satisfactory. The tube must be airtight at all times, or compressed air will blow into the molten steel causing pyrotechnics of considerable magnitude.

General Description of Process

Melting. Selected steel scrap and pig iron are melted in a 9-ft basic-lined Swindell arc furnace. A single slag process is used and complete deoxidization is accomplished in the ladle by adding 2 lb of aluminum and 2 lb of calcium-silicon manganese per ton of steel. Because an economical method of breaking steel wheels was found, complete charges of broken steel wheels and pig iron have been used successfully. It was found that by nicking the steel wheels slightly on the rim with an oxyacetylene torch they can be broken satisfactorily in our standard car-wheel breaker. Whole wheels have been used but power consumption is high and electrode breakage excessive.

A complete chemical analysis is made during all phases of the heat, and the chemistry is controlled closely. Our present required composition is as follows: Carbon, 0.65 to 0.75; manganese, 0.60 to 0.85; silicon, 0.15 min; phosphorus, 0.05 max; sulphur, 0.05 max. Temperature control is maintained by an immersion-type rayotube. The furnace is tapped at 3150 F.

Electric furnaces were chosen for melting because it was felt that the finest possible steel could be produced, control would be simpler, and quality could be maintained easily. The ease with which the temperature could be regulated was also a factor.

The metallurgy of steel wheels is a problem which has not yet been solved. In all probability an alloy composition will prove beneficial for heavy-duty service. We hope to study this problem and, as is known, an electric furnace is ideal for producing any and all types of steel.

Pouring. We tap approximately 16,000 lb of steel into an insulated ladle. This ladle of metal will produce 20 wheels. The steel is slagged off and the ladle is then placed in the pressure tank. An immersion thermocouple of platinum and rhodium is used to determine the temperature of the steel. We consider 2950 F the ideal pouring temperature. A layer of sand is placed on top of the steel to prevent it from cooling too rapidly during the pour. The preheated tube is then lowered into the ladle. The entire 20 wheels are poured by the pressure-pouring process in about 20 min. The pressure in the tank is built up at a rate of 1 lb per sec until the metal enters the mold, at which time the rate is decreased to $^1/_2$ lb per sec.

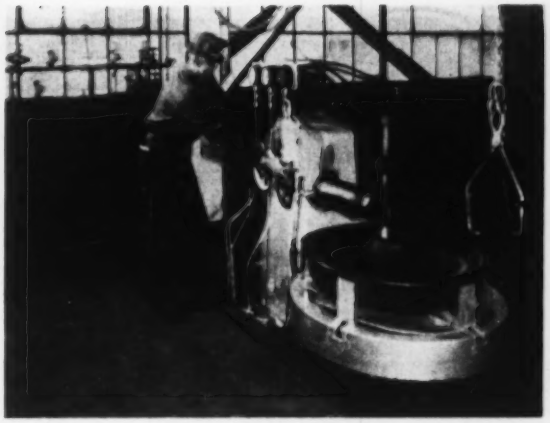


Fig. 7 Hub-cutting machine

The entire pouring operation is controlled automatically so that the operator has only to push a button to pour a wheel. The actual time to pour a wheel is about 25 sec. To stop the pour, the operator watches the metal coming up in the highest of the three 4-in. risers and when he sees that it has reached the proper height, he

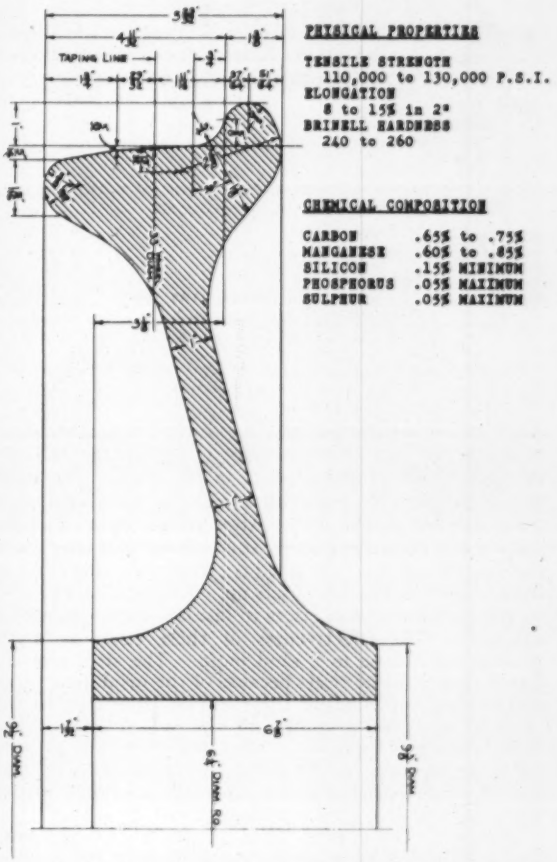
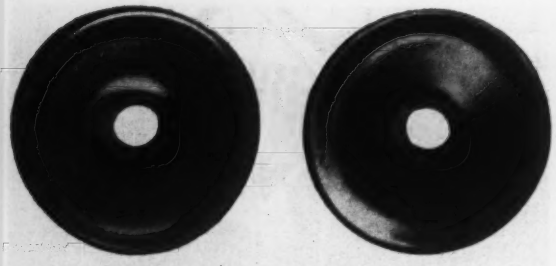


Fig. 8 Dimensions of AAR (X-3) EQS wheel for 50-ton cars



AAR (X-3) EQS steel wheel for 50-ton cars

Fig. 9 Front view

Fig. 10 Back view

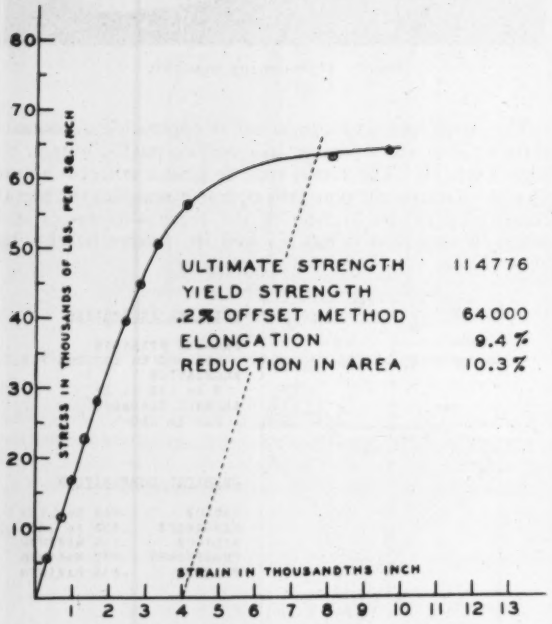


Fig. 11 Stress-strain diagram of heat-treated tread metal

stops the operation by pressing another button. This activates an air cylinder which pushes the stopper through the steel and seats it in the drag. The stopper consists of a piece of coated-steel pipe with a graphite plug fastened to the end. After the stopper has been seated, the controlled air is shut off and the air in the tank is exhausted. The mold is clamped by air cylinders for 20 sec while the wheel sets up. Rice hulls are poured on the top of the three risers to insulate them for greater efficiency. The effectiveness of these risers is much greater than those in a sand mold. The steel remains liquid longer in the risers because of the insulating value of the sand surrounding the risers as compared to the chilling effect of graphite on the wheel itself. The steel in the mold sets up in a matter of seconds as compared to minutes in the risers. A new mold is then brought into position by an especially designed gantry crane and the process is repeated.

Shakeout. The cope is lifted off at the end of 5 min. The solidified portion of the risers stays in the cope as the metal is still molten at the $1^1/_4$-in. sprue. The three risers are brushed off and compressed air is blown on the sprues for 1 min with an especially designed cooling fixture. This equalizes the temperature in the wheel and prevents hot cracks. The wheel is then lifted off the drag and carried through a slow-cooling kiln on a monorail. The steel cools from approximately 2000 F to 1200 F in this kiln. At this point the riser stubs are washed off with an oxyacetylene torch, the graphite stopper is chipped off, and the wheel is ready for hub-cutting.

Hub-Cutting. The solid hub of the wheel is removed by an especially designed machine with an oxyacetylene torch. The stopper pipe is used as a pilot hole through the hub, and initially iron powder is used in conjunction with the oxygen and acetylene to start the cut. The cut surface is amazingly smooth and can be held to within $^1/_8$ in. It takes approximately 2 min to complete the cut and approximately 20 ft of oxygen are required. The temperature of the wheel at the end of this operation is 1100 F.

Heat-Treating. After the cutting operation the entire wheel has cooled through the lower critical temperature. It is placed in a pit-type gas-fired furnace. This furnace will hold 20 wheels stacked on top of each other and is fired with 15 tangentially firing gas burners. The wheels are baffled completely from flame impingement and are under complete control at all times. The wheels are heated to 1550 F, equalized at this temperature, and held for 1 hr. They are then removed and air-cooled for 15 min. Next, the wheels are placed in a cooling pit and left to cool for 24 hr.

The wheels, when cooled, are shot-blasted, strength-tested, magnaglo-inspected, weighed, taped, checked for rotundity, and inspected for final approval.

Drag. After the wheel is removed, the drag is wiped off and examined. The stopper seat is checked and the pouring tube is cleaned with a wire brush. If the stopper seat has eroded it is often remachined in position with an auger designed for this purpose. The drag mold is then sprayed with a silica-base wash and is again ready for use.

Cope. The riser sand is cleaned out of the riser holes with an electric brush. The cope is wiped off and inspected.

Phenolic Binders for Graphite Molds

One of the most valuable contributions to the development of graphite molding was the discovery of phenolic binders without which graphite molds would be impracticable. The three riser holes in the copes of our graphite molds must be lined with sand to protect the mold from erosion and to facilitate removal of the risers without mechanical abuse to the graphite. This is accomplished by placing the cope section on an electrical resistance plate machined to the contour of the mold, lowering riser forms into the riser holes, and pouring a mixture of 98 per cent silica sand and 2 per cent phenolic binder around the forms. The riser cores are baked within a matter of seconds from the heat of the plate and the residual heat of the graphite mold in which we have recently cast a wheel. The cope is then sprayed with a silica-base wash and is ready for use.

The design of a wheel made in a graphite mold is limited because it must be free to contract on solidification without excessive restraint. Initially, hot tears under the rim and flange were a factor until the rim and

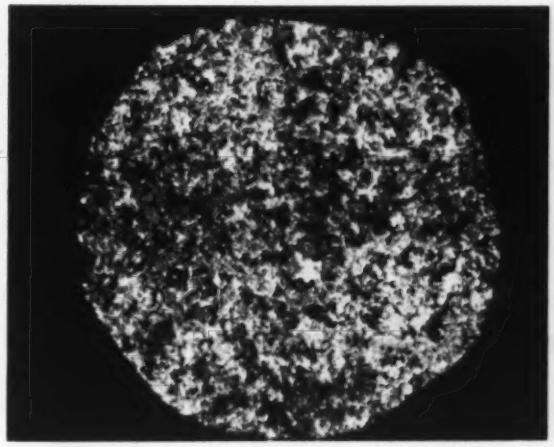


Fig. 12 Photomicrograph of heat-treated sample; ×100

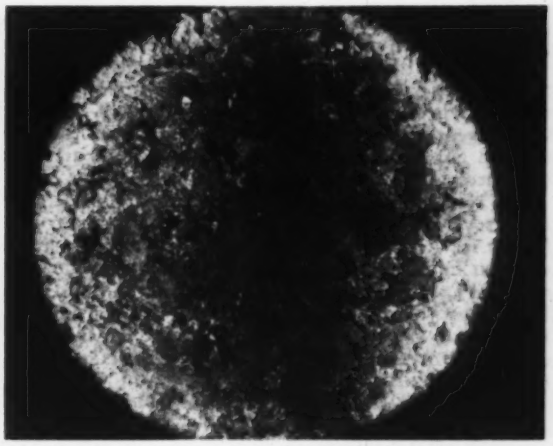


Fig. 13 Photomicrograph of heat-treated sample; ×500

flange fillets were increased. The resulting long sweeping fillets under the rim and the flange lend additional support to these members and facilitate removal of the wheel from the mold. They also tend to create smooth-flowing internal stress lines lacking in stress concentration. It is felt that the additional metal of the fillets has a tendency to dissipate heat from the tread developed by brake-shoe action.

The tolerances between graphite molds are very close, within 0.020 in., because the whole mold is machined with a one-piece tool, contour-ground to a template. Wheels can be produced within two tape sizes. It is a simple matter to remachine a mold with these tools and wheel uniformity is assured. As a result, the balance of the graphite-mold wheel is closer than other types.

Physical Properties

Steel taken from test wheels shows the following physical properties: Tensile strength, 110,000 to 130,000 psi; yield point, 60,000 psi; elongation, 8 to 15 per cent in 2 in.; Brinell hardness, 240 to 260.

Also, the following tests have been run on the wheels:

Drag Test. One wheel was subjected to ten drag tests. The surface speed of the wheel was held constant at 45 mph. The standard AAR passenger-car shoes which were used were all taken from one heat and were applied with a force of 3000 lb per shoe for 50 sec out of each minute for a total duration of 30 min for each drag test.

Stop Test. Three wheels were stop-tested. The wheels were stopped from an initial surface speed of approximately 105 mph with clasp brakes with a force of 20,000 lb on each of two shoes. The flywheel of the testing machine has a mass equivalent to a rail-wheel load of approximately 24,000 lb. The energy dissipated for each stop from a speed of 105 mph was slightly greater than 9 million ft-lb. Each wheel was subjected to 50 complete stops. In addition, ten tests were run on each wheel so that only 50 per cent of the foregoing energy was dissipated per test.

The tests were as follows: Five tests were conducted in which the initial speed was adjusted so that only 50 per cent of the energy available was dissipated (brakes applied at approximately 74 mph and released at zero mph); five tests in which the brakes were released after

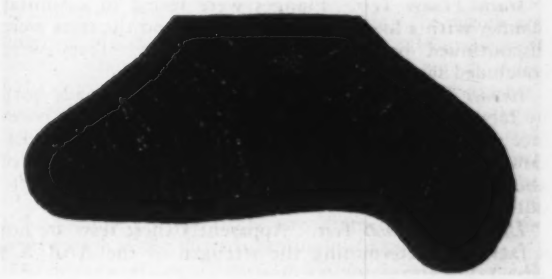


Fig. 14 Cross section showing dendritic structure of non-heat-treated tread section

Fig. 15 Cross section showing structure of heat-treated tread section

50 per cent of the energy had been dissipated (brakes applied at approximately 105 mph and released at 74 mph). After the release of the brakes the wheels were allowed to cool in air for 8 min and then cooled by spraying water on the tread of the wheel.

Test Results. The residual stresses present in the wheels as manufactured are changed after each drag test. This is caused from the temperature gradient between the rim and the hub which produces compressive stresses of appreciable magnitude in the tangential direction in the rim and causes plastic deformation. After

cooling to room temperature, tangential stresses are developed which modify the previous stress pattern.

The residual stresses present in the AAR X-3 wheel after ten drag tests were not high enough to be dangerous for wheel failure. In fact, one AAR X-3 wheel was sawed radially through to the hub after the test and did not fracture until less than $^1/_{16}$ in. of material remained.

The tests imposed on these wheels were considerably more severe than conceivably could be encountered in freight service. The clasp shoes used in the test increase the heat input to the wheel, and in the case of the drag test the cycling of the brakes permits the shoes to last longer than if the shoes were applied continually. In general, the wheels tested would withstand any thermal load that normally might be encountered in freight service.

Static Rim Test. In this test the rim of a wheel is supported and a load is placed on the back hub. The capacity of the test machine used was 1 million lb. The wheels withstood the capacity load of the machine without failure.

Static Flange Test. Flanges were tested in a similar manner with a load of over 600,000 lb and the tests were discontinued because of flange bending. Tests were concluded without fracture.

Impact Test on Rim. Impact rim tests were made both by repeated blows at the same spot 1 in. from the outer face of the rim, and by repeated blows at the same distance in from the tread but with a wheel rotation of about 1 in. after each blow. Tests were concluded without failure.

Drop and Thermal Test. Apparently these tests are not a factor in determining the strength of the AAR X-3 wheel.

Drop: The wheels withstood 100 blows with a 250-lb tup from a height of 20 ft. No failures were recorded. One wheel went 329 blows and test was discontinued.

Thermal: Three consecutive tests were conducted with a 6-in. band of molten metal. No indication of failure was apparent.

Mounting Practice. The AAR steel-wheel procedure is followed in mounting AAR (X-3) EQS wheels.

Service and Wear Tests. At the present time the author's company has 1312 AAR (X-3) EQS wheels on test under cars of 32 Class I railroads and private-car lines. They have been placed in all types of service under 40, 50, and 70-ton-capacity cars. The first test wheels were placed in service in May, 1952.

No impressive service has been established as yet; nevertheless, with mileage figures available on less than 40 per cent of these wheels, the total wheel miles reported to date are 9,085, 298. In all cases the wheels examined have shown superior wear qualities. We believe the reason for these results lies in the directional formation of the dendrites which are perpendicular to the tread and flange surfaces. This can be seen clearly in Fig. 14. We believe the direction of the dendrites produces a superior wear surface in that it enables the wheels to wear against the so-called fiber ends of the metal structure.

Conclusion

We are convinced from service and laboratory tests, and from the production success we have enjoyed at our pilot plant, that a product of superior quality has been developed. On the strength of this information and our past experience, we have undertaken to build two production plants, one at Chicago, Ill., and one at St. Hyacinthe, Quebec. These plants are due to start operation in January, 1954.

Acknowledgment

The research conducted by the Great Lakes Carbon Corporation in perfecting graphite used for molds is gratefully acknowledged.

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National Bureau of Standards

THE SETTING of measurement standards was the primary reason for founding the National Bureau of Standards in 1901, according to an article in the *Scientific Monthly*, December, 1953. Since then, however, the standardization work branched to fields undreamed of when the Bureau was started. Government agencies and industries soon began to ask more and more from the National Bureau of Standards. The United States then, as now, was the biggest purchaser in the country and, like any good buyer, wanted its purchases to measure up to the rights of the buyer. The Bureau was called on to test the materials, particularly cement for dam-building projects, for which the government was to pay. Manufacturers first used the services of the Bureau for checking accuracies of their scientific instruments, but it was not long before other producers also turned to the Bureau for help. In 1907, for example, at the request of the American Foundrymen's Association and the Association of American Steel Manufacturers, it undertook the analysis and distribution of standard samples of steels and irons which industries needed for their own comparative checkings. Later, it co-operated with the American Chemical Society to insure uniformity in technical analysis for the improved quality of chemical reagents.

The all-inclusive "solution of problems" clause in the bill that created the Bureau became the authority wherever there was doubt that the Bureau could legally take on a research project for other government agencies, or for industry, or private groups such as the baseball leagues. The Bureau undertook one baseball study to solve the annual complaint that home-runs records were being broken because baseball makers were producing livelier balls. By rigging up a baseball device, Bureau scientists found that the complaint was not justified. The balls, old and new, showed the same liveliness.

Much of the work of the Bureau has been done to make the work of others easier. Take the dollar bills you use today. They may not go as far as the dollars of years ago, but they get there in better condition. The paper currency of today seldom tears because Bureau scientists test the paper stock on machines that fold and unfold it thousands of times. If the paper is not strong, it is not used to make money. Bureau scientists, also, invented an electronic machine for the more effortless counting of mutilated and outworn paper money that is to be destroyed.

Occasionally, the Bureau employees are used for some of its testings. Not content to rely upon the results of machine-testing of shoe soles, the scientists outfitted Bureau guards with shoe soles of the material under test and let the guards wear them out normally.

Determining Weight Electronically

A Tool for Control and Measurement Procedures

By Verne C. Kennedy

President, Streeter-Amet Company, Chicago, Ill.

FUNDAMENTALLY, the electronic scale comprises three basic elements, i.e., the load cells, the servosystem, and the data-presentation device. During operation, the weight to be measured is placed on the load cells. The load cells, consisting of small electrical units sensitive to mechanical force, immediately thereupon produce an output voltage proportional to the applied weight.

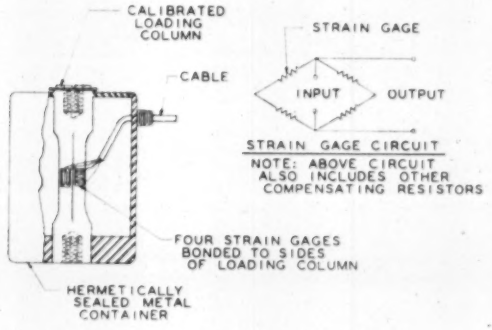

Fig. 1 Internal details of load cell

This proportional voltage is fed into the servosystem which interprets the magnitude of the voltage by adjusting a balancing potentiometer automatically to an equivalent position. At the same time the servosystem positions the potentiometer, it also positions the data-presentation device (digit wheels in a printer, pointer of a dial, and so on) to a corresponding position. The applied weight on the load cells is then printed and/or visually indicated by the data-presentation device.

Contributed by the Instruments and Regulators Division of THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS and presented at the Eighth National Instrument Conference, Chicago, Ill., September 21–25, 1953.

Basic Elements

Load Cell. The load cell, internal details of which are shown in Fig. 1, consists essentially of a calibrated steel loading column, four strain gages bonded to the sides of the column, and a hermetically sealed metal container. The four strain gages, each consisting of a fine resistance wire laid back and forth on a thin strip of impregnated paper, are connected electrically in the form of a Wheatstone bridge. Two diametrically opposite corners of the bridge are connected in series with the input terminals of the load cell. The other two diametrically opposite corners serve as the output terminals of the load cell.

During operation, a constant a-c voltage is impressed across the input terminals of the cell. The magnitude of the resultant voltage which appears across the output terminals of the cell depends entirely on the degree of electrical unbalance existing in the strain-gage bridge circuit—the greater the unbalance, the greater the output voltage.

For no-load conditions, the output voltage of the cell is equal to zero. This results from the fact that when the strain gages are not under stress, the resistance of each is of such a value that the bridge is in electrical balance and, therefore, the resultant output voltage is equal to zero.

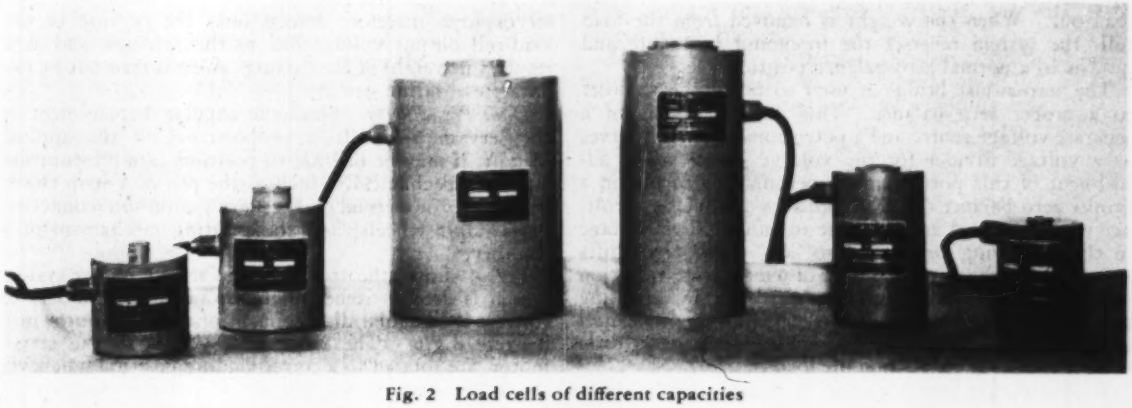

Fig. 2 Load cells of different capacities

When a load is placed on the steel loading column, both the column and attached strain gages are deformed slightly. The deformation occurring in the strain gages changes the respective resistance value of each, which in turn, unbalances the bridge. Since the bridge is no longer in electrical balance, a small resultant voltage appears at the output terminals of the cell. Owing to careful calibration of the cell, this small output voltage is proportional to the amount of the load the cell is supporting. Proper instrumentation is then utilized to measure the voltage and determine the amount of load it represents. Fig. 2 shows different load cells.

Servosystem. The servosystem measures the load-cell output voltage by comparing it with a reference a-c voltage. Major components of the servosystem are, as shown in Fig. 3, a balance bridge, an amplifier, a two-directional servomotor, and a zero-adjust bridge. Initially with no load on the load cell and, therefore, zero output voltage, the system is at zero balance. However, if a load is then placed on the load cell, the load-cell output voltage increases a corresponding amount and a finite portion of this voltage appears across the amplifier-input terminals. The amplifier amplifies the input voltage considerably and then directs it to the servo-balance motor. The servomotor as a result starts to operate and drive through a mechanical gear system both the rotary precision potentiometer in the balance bridge and the movable element of the data-presentation device, that is, in this latter case, the pointer of a dial, digit wheels in a printer, and so on.

Owing to the adjustment of the precision potentiometer, a portion of the reference voltage appears across the balance bridge—between points X and Y. This resultant voltage across the bridge is in opposition to the load-cell voltage and progressively increases in value as long as the servomotor continues to drive the potentiometer slider away from its original position, point a. The servomotor continues to run until the balance bridge opposing voltage is equal in magnitude to the load-cell voltage. The motor then stops because the two voltages have canceled one another out, leaving zero voltage impressed across the amplifier-input terminals, or zero power to drive the motor further. This constitutes a balance point for the system and it will remain as such until the load-cell voltage is changed. Since the servomotor, the precision potentiometer, and the data-presentation device all work in synchronism with one another, the weight represented by the load-cell voltage also has been positioned on the data-presentation device and may be printed immediately or visually read out. When the weight is removed from the load cell, the system reverses the foregoing procedure and returns to a normal zero-balance position.

The zero-adjust bridge is used to bring the recorder to a proper zero balance. This device consists of a separate voltage source and a potentiometer which serves as a voltage divider for the voltage source. The adjustment of this potentiometer permits one to obtain a proper zero balance of the recorder by producing a voltage which is equal and opposite to an undesired voltage in the measuring circuit. Also, any slight zero shifts which might then occur because of temperature variation or other causes can be compensated readily by adjusting this control. In many cases this control is used to cancel out the voltage caused by a weighbridge or other form of load-receiving element on the load cells.

If tare-weight compensation is desired in a scale, a

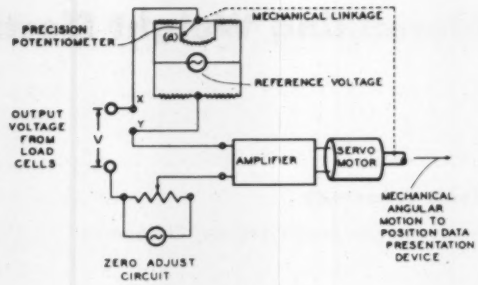

Fig. 3 Servosystem

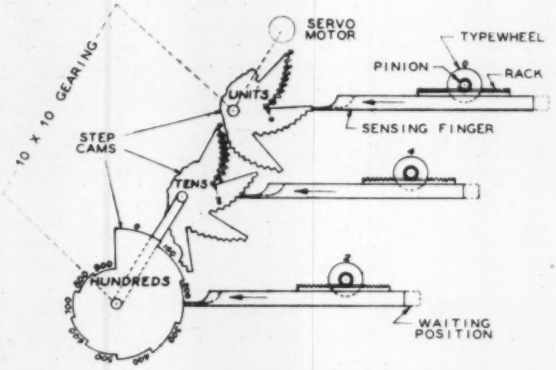

Fig. 4 Step-cam and typewheel assembly with correlation, correlator disks, and step-over mechanism omitted

device similar to the zero-adjust control, consisting of another separate voltage source and potentiometer, is incorporated into the servosystem. However, in this case the potentiometer is varied by means of a hand dial calibrated in weight units. The dial is set to the indicated tare weight for each load.

For example, if a box having a known tare weight of 500 lb and containing several castings is placed on the scale and only the weight of the castings is desired, the tare-weight compensating dial is set to 500. At this setting the tare-weight potentiometer produces an opposing voltage which cancels out the portion of load-cell output voltage due to the weight of the box. The servosystem therefore detects only the portion of the load-cell output voltage due to the castings, and as a result, the weight of the castings alone is read out by the data-presentation device.

Data Presentation. Since the angular displacement of the servomotor shaft is proportional to the applied weight, it may be utilized to position data-presentation elements mechanically, such as the pen of a strip chart, the pointer of a visual dial, geneva pinion-interconnected visual digit wheels, and the printing mechanism of a recorder.

Fig. 4 shows the step cam and sensing-finger system which is used in some full figure printing recorders to convert the angular displacement of the servomotor into discrete digits. The step cams, geared to the servomotor, are rotated to a corresponding position whenever the servosystem seeks out a null-balance point for a

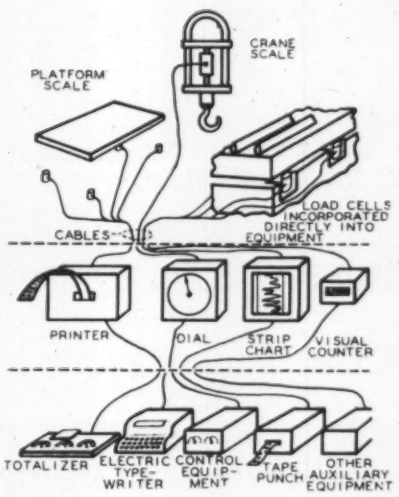

Fig. 5 Basic electronic-scale systems

weight. Then, once the servomotor has brought the step cams to a standstill balance position, the sensing fingers move forward from their waiting positions and engage the cams. The length of travel of each finger depends on the depth of the particular step aligned in front of it, while the depth in turn corresponds to a certain digit. As each sensing finger moves forward, its attached rack meshes with the pinion of its associated type wheel and rotates the wheel to a printing position corresponding to the digit being detected on the step cam.

Once all of the type wheels have been positioned in this manner, the print hammer snaps down and records the value of the weight on a card or tape held immediately above the type wheels. The sensing fingers then move back to their waiting positions until the next weight is to be printed.

Basic Scale Systems

Fig. 5 gives an over-all idea of basic electronic weighing systems. Load detection may be accomplished by placing load cells under a conventional weighbridge, by utilizing a crane-scale load cell with attached hook, or by incorporating load cells into various types of equipment in a great number of diverse ways. Cables convey the electrical weight information from the load cell to the instrument of the electronic scale.

For simple scale applications, the instrument contains the servosystem and one or more data-presentation devices, such as a printer or a printer combined with a visual dial. When batching, regulation, intermittent feeding, and other automatic processes are involved, additional instrumentation is included in the weighing system.

Limitations of Load Cells

Most important factors to be considered in the design of an electronic weighing installation are the inherent operating characteristics of the load cells. The installation and use of load cells of the resistance type are limited by four controlling factors—excessive overloading, shock, eccentric loading, and rapid temperature change. Although careful attention always should be given to these factors, they do not necessarily impose any serious limitations on the general use of the electronic scale.

Excessive Overloading. Overloads up to 120 per cent of rated cell capacity will do a cell no harm, either mechanically or electrically. Overloads of 150 per cent of rated cell capacity may cause a slight zero shift, but otherwise will not affect the measuring qualities of the cell unless continually repeated, in which case the life span of the cell will be shortened. Repeated overloads of 200 per cent of rated capacity and greater will harm the cell.

Shock. Owing to their high response speed, load cells also react to shock loads. The peak value of the impact force on a cell should not exceed 120 per cent of its rated capacity.

Eccentric Loading. No mechanical harm will result if a lateral component of load force not exceeding 25 per cent of the rated cell capacity is applied to the end of a cell perpendicular to the center axis of the loading column. However, while such a lateral load force does not harm the cell mechanically, it definitely does introduce considerable errors into the electrical measuring qualities of the cell since both the loading column and strain gages are deformed improperly. Therefore it is essential that the load force be exerted directly along the center axis of the loading column—at least when a reading is being taken.

Temperature. In general, load cells are well compensated for normal ambient temperature changes and are designed to operate at temperatures ranging from slightly below 0 F to a maximum of 150 F. With certain precautions it is also possible to operate the cells at somewhat higher and lower temperatures.

Other Load-Cell Considerations

Sealing. Certain types of load cells are hermetically sealed and may be installed to operate under adverse conditions. Oil, water, and dirt will not affect their accuracy.

Number of Cells. Either a single cell or several cells may be used to support a load. Up to sixteen cells have been used to support a single weighbridge. When more than one cell is used, the electrical output terminals of the various cells are connected in series and the combined voltage thus obtained represents the total load supported by the cells.

Accuracy. The calibration accuracy of load cells normally used for weighing installation is 0.1 per cent of rated capacity throughout the weighing range.

Load-Cell Capacities. At the present time, available load-cell capacities range from 200 to 200,000 lb.

Physical Dimensions. Small-capacity cells have over-all heights somewhat less than 5 in. and an OD of approximately 3 in.; 200,000-lb-rated-capacity cells have an approximate over-all height of 10 in. and an OD of 7 in.

Tension and Compression. In many cases, load cells are so designed that they may be used in either tension or compression.

Electrical Power. Load cells may be operated on either a-c or d-c electrical power.

Distortion Under Load. Dimensionally, load cells change very little when placed under load. The maxi-

mum deflection which may occur in the steel loading column for rated capacity load is of the order of 0.005 to 0.010 in.

Interchangeability. In the event that a cell is damaged, it can be removed with relative ease and a new cell of equal capacity mounted in its place.

Power Supply for System

At the present time virtually all electronic scales are designed to operate on a-c power. The principal reason for utilizing alternating current is that it enables a transformer to be employed to provide the individual power supplies for the load cells and various measuring-circuit elements—reference voltage, zero-adjust voltage, and so on. The particular type of transformer which is used has a single primary winding and several secondary windings. The primary winding is connected to the incoming power line and the secondary windings serve as the various individual power supplies.

An important advantage provided by this type of arrangement is that voltage fluctuations occurring in the incoming power line are reflected by a proportional amount into each of the secondary windings. Since all of the secondary windings, or individual power supplies, undergo the same proportional change, the overall scale circuit tends to maintain its same relative point of balance and thus does not change appreciably with power-line fluctuations. However, when power-line fluctuations become excessive, voltage-regulating equipment must be incorporated into the scale.

The use of d-c power in an electronic-scale system poses as somewhat of a problem because of the close tolerances to which the individual d-c voltage supplies must be maintained at all times. Although d-c power can be used, a-c power is preferred at the present time.

Circuit Shielding

Cables. All cables external to the instrument and containing portions of the load-cell circuit or general measuring circuit must be shielded and the shields grounded. This is necessary to prevent stray fields from influencing the operation of the scale. Whenever possible, cables should be installed in conduit.

In general, when using standard electronic-scale equipment, load cells may be located up to 200 ft from the recorder. Controlling factor in this regard is the temperature coefficient of resistance of the cable wires. If the interconnecting cables exceed 200 ft, normal temperature variation may cause sufficient line-drop fluctuation (owing to cable resistance variation) to affect the accuracy of the scale. However, with careful study and utilization of modified equipment it is frequently possible to extend the distance considerably beyond 200 ft.

Accuracy. Under normal industrial conditions and with properly designed instrumentation, the accuracy of electronic weighing systems is comparable with the best mechanical weighing systems. In general, most weighing installations may be furnished to meet commercial tolerances recommended by the United States National Bureau of Standards.

Acceptance of Electronic Weighing. Electronic weighing has been accepted officially by all states to which a request for acceptance has been submitted.

The two most noteworthy aspects of electronic weighing are (1) the relatively small size of the load-detection units, the load cells, and (2) the fact that the weight information is conveyed from the load cells to the instrument by means of an electrical signal passing through a flexible cable.

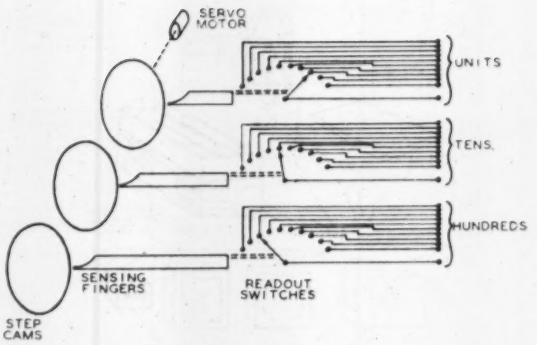

Fig. 6 Electrical read out for step-over system

Owing to the small size of the load cells, the structure of the scale may be kept at a minimum and highly functional designs are possible. Also, load cells may be incorporated into certain existing equipment which would preclude the use of more conventional types of weighing systems. Another factor to be considered is that, inasmuch as both the load cells and the instrument are self-contained units, they somewhat lend themselves to portability. This especially applies to the crane-scale type of application.

Remote recording and regulation present no real problem in electronic weighing. Cables from the load cells may be brought equally well to an instrument standing next to the load cells or to one located at a more convenient remote point. The fact that the load cells and instrument are electrically interconnected also makes multiweigh-station recording possible. A remotely located recorder with a weigh-station selector switch can successively switch in and record the weights detected by different groups of load cells situated at widely separated points throughout a plant. The recording can be actuated either manually or automatically. If necessary, a weigh-station identification letter or mark can be printed opposite each weight reading.

Extension of Basic Instrumentation

A wide variety of computational and control devices may be combined readily with the basic instrumentation of the electronic scale to work in an integrated manner with it.

Electrical Readout. The electrical read out mechanism illustrated in Fig. 6 consists essentially of a bank of wiping switches. Each switch has ten contact positions, representing the digits 0 to 9, and operates in conjunction with a specific sensing finger. Whenever the sensing fingers move into their respective step cams to detect the digits of a weight, they also simultaneously move the arms of their associated switches to corresponding positions. Thus with proper circuitry extending from these switches, it is possible to deliver the digital-weight information detected on the step cams to such other equipment as totalizers, tape punches, electrical typewriters, and so on.

Fig. 7 Crane scale in operation

Control Devices. Since in essence the electronic scale converts a weight force into a proportional angular displacement of a motor shaft, controlling devices may be adapted readily to the scale to perform various functions. In general, by attaching cams to the servomotor drive shaft to actuate switches at given points of rotation and by utilizing other electrical components such as timers, many varied types of sequential controlling procedures are possible. Mercury switches also may be used to detect discrete points of rotation of the servomotor shaft.

Use of Slip Clutch. In some weighing applications it is desirable to record incremental increases or decreases in load, rather than the total load on the scale. A slip clutch is incorporated between the servomotor and recording mechanism to accomplish this. For example, several different commodities may be placed on a blast-furnace scale car before it is dumped, yet it is necessary that the weight of each commodity be recorded. In this case, after each commodity is placed on the car scale and recorded, the slip clutch between the servomotor and step cams is disengaged temporarily while a return motor moves the recording mechanism back to the zero position. The clutch is then engaged again. As a result, only the weight of the succeeding load will be recorded, even though the instrument as a whole and the visual dial on the car are positioned for the total load.

For "loss in weight feeding" applications, the foregoing general procedure is followed but the recording mechanism is designed "backwards" so that each decrease in weight may read out directly.

One of the most important contributions made by electronic weighing in the general field of industrial weight measurement is, no doubt, that of the crane scale. Electronic-weighing components when utilized in this manner essentially reduce transportation and weighing of heavy materials into one operation. The crane-scale unit illustrated in Fig. 7 is manufactured as a complete assembly and consists primarily of a load cell with a lifting eye on top and conventional crane hook on the bottom. A spring take-up reel gives out and takes up cable for this unit as it moves about, and a remotely located recorder prints the weight of each load supported by it. In general, almost any crane installation can be converted more or less readily into a scale simply by placing one of these load cell-and-hook assemblies on the existing crane hook and mounting the sping take-up reel and recorder at some appropriate remote point—usually in the crane-operator's cab.

Crane-Scale Operation

Interconnecting Cable. Owing to the very precise measurement of load-cell voltage required, slip-ring or brush contacts cannot be used. Sufficient freedom of travel for the crane is provided through the use of a spring take-up reel or a looped conductor.

Weighing Procedure. In order to get an accurate reading of the weight, the crane travel must be stopped momentarily while the reading is being taken. However, in virtually all cases, this momentary pause is so short, lasting but a few seconds, that it does not decrease the effectiveness of the scale.

Safety Factor. The safety harness about the load cell is so designed that the load cell alone will support within rated capacity loads. However, if the load cell should be overloaded severely or should snap for one reason or another, the safety harness in turn will support the load.

The hook of the load-detection unit is designed with a designated "weak spot." Thus if an attempt were made to pick up an excessively high overload, which probably would damage the crane apparatus, the hook will straighten out and the crane will not be able to pull the load off the ground.

The swivel housing between the hook and cell aids in general handling procedures and prevents torsional oscillations of the load which otherwise might prove to be dangerous to nearby personnel and have a tendency to introduce errors in the scale readings.

Modifying Scales With Electronic Elements

For the purpose of allowing remote recording and for getting around unforeseen physical space-limitation problems, conventional mechanical beam scales sometimes are modified so that electronic-weighing elements may be incorporated into them to read out the weight values. When only remote recording is desired, the foregoing usually is accomplished by mounting a load-cell in tension in the beam rod and removing the upper end of the beam rod from the weighbeam and fixing it securely to some nearby support member. Thus the same weight forces which formerly were transmitted by the beam rod to one end of the weighbeam and balanced out by moving a counterpoise on the other end of the weighbeam are, instead, detected by the load cell. However, since the weight force detected by the load cell is not the true weight on the scale, but rather a submultiple of it, the instrument also must be calibrated in terms of the multiple—this offers no problem. Load cells also can be mounted in either tension or compression anywhere along the length of the transverse lever.

The capacity of a relatively small mechanical beam

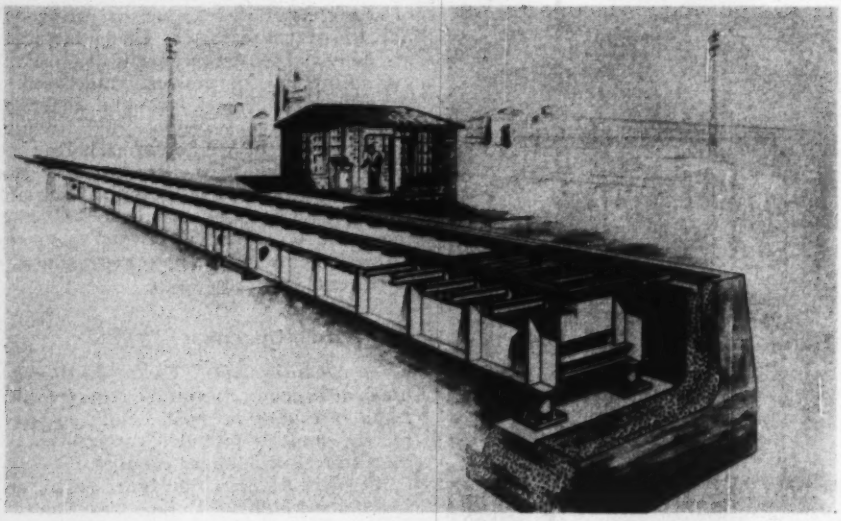

Fig. 8 Railroad track scale

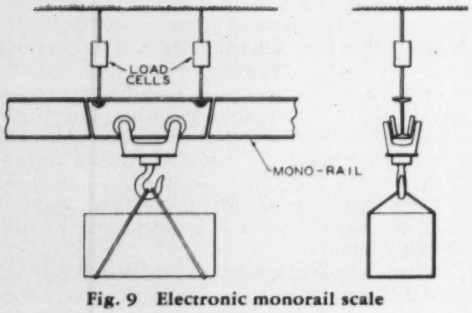

Fig. 9 Electronic monorail scale

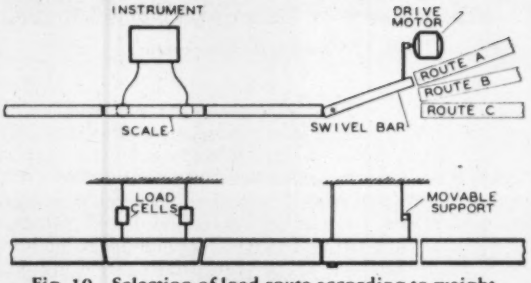

Fig. 10 Selection of load route according to weight classification

scale may be increased considerably by replacing the existing lever system with load cells having a higher total capacity. However, this probably would require certain modifications.

Motion Weighing

Track Scales. Motion-weighing track scales for railroads, steel mills, mines, and the like are constructed by mounting load cells in a concrete scale pit and placing a conventional type of weighbridge on top of the cells.

Fig. 8 illustrates the construction of a large railroad track scale. Pits used for electronic scales are somewhat smaller than those required for conventional beam scales of equal capacity. This results because of the small physical size of the load cells plus the fact that there is no need to provide space for a transverse lever. Also, in some cases the size of the weighbridge can be reduced materially by installing several load cells to support it at many points.

Conveyer Scales. Load cells may be mounted in a section of the support structure of a conveyer line to provide a conveyer type of scale. For belt conveyers and the like the instrument may be adapted to indicate the rate of flow of material.

Monorail Scales. The small size of the load cell and the inherent quality of remote recording enables electronic weighing to be used to good advantage in various overhead-rail lines. For example, an existing monorail may be provided readily with a weight-determination point by supporting a section of the rail with load cells. In Fig. 9, when objects after being weighed are to be channeled along different routes according to weight classification, the instrument can be designed to regulate selective switching or dumping apparatus further on down the rail line. In Fig. 10, as each object is weighed, the instrument in addition to recording the weight also operates a drive motor which swings the swivel rail to the particular rail route corresponding to the weight detected.

Hopper Applications

Fig. 11 illustrates how load cells may be incorporated into the support structure of a hopper. When corrosive fumes are present, the fact that the load cells are hermetically sealed units is of particular importance. Various batching sequences may be controlled closely by instrumentation located at a close or remote point.

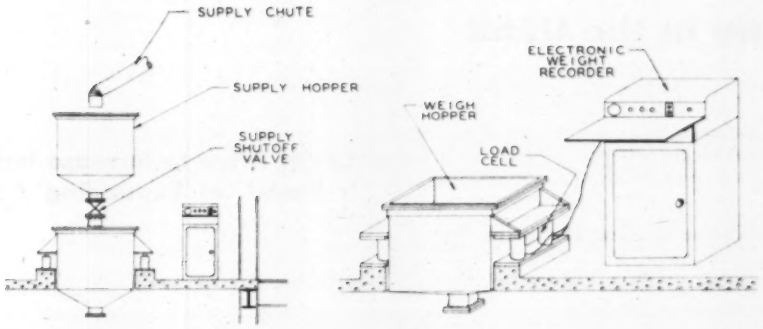

Fig. 11 Electronic scale for hopper

Rate of Flow Control. The possibility of using electronic-weighing elements in conjunction with a flow valve to control rate of flow accurately deserves special consideration. Fig. 12 suggests one of many possible methods. Load cells are used to support a tank from which molten sulphur is to flow at a certain rate. The controlling device consists essentially of a differential gear unit, a synchronous motor (constant speed), a rheostat, and a valve-actuating motor. The shaft at one end of the differential gear unit is connected to the servomotor; the shaft at the other end is connected to the synchronous motor. The center shaft is connected to the rheostat.

As the sulphur pours out, the weight detected by the scale is being reduced continually and this causes the servomotor to rotate its side of the gear unit continuously. The synchronous motor also continually rotates its side of the gear unit, but at a constant speed. The synchronous motor is so chosen that its speed corresponds to the speed at which the servomotor will turn if the sulphur is flowing at the proper rate. Thus, when proper rate of flow occurs, the two motors turn their respective sides of the gear unit at equal rates and the center shaft remains motionless. However, if the servomotor either leads or lags the synchronous motor, because of improper rate of flow, the center shaft also turns and adjusts the rheostat. The adjustment of the rheostat actuates the motor which, in turn, adjusts the valve until the proper rate of flow is established again. This mechanism therefore will adjust the rate of flow whenever necessary.

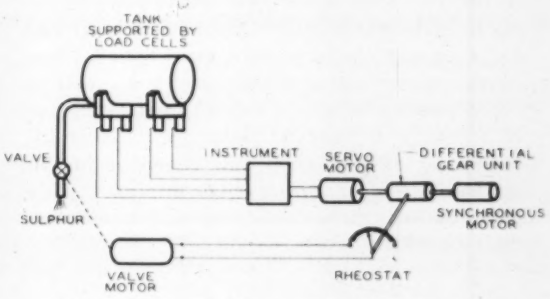

Fig. 12 Theoretical rate-of-flow control system

Future of Electronic Weighing

Although the components and techniques of electronic weighing already have undergone much advancement and are now in successful use in numerous installations, electronic weighing as a whole may still be regarded as being in its infancy. This becomes apparent when the ultimate potentialities of electronic-weight determination are examined. For example, the load cell has as one of its many useful characteristics the quality of being able to convert a weight force into a proportional voltage in a fraction of a second. This fast response time undoubtedly will pave the wave to various high-speed-motion weight installations. Envisioned, and perhaps already under test, are electronics scales capable of detecting weights of vehicles moving at speeds of 60 mph and greater.

As another illustration, consider the crane scale. In its present form it has proved to be a versatile device and those companies using it are enthusiastic about its ability substantially to reduce the number of operations required in the handling and weighing of heavy materials. However, if the spring reel and interconnecting cable of this scale were to be replaced by a radio transmitter-and-receiver arrangement to transmit weight data from the load cell to the recorder, it is seen that the versatility of the scale would be enhanced greatly.

The fact that the load cell is very small in size (relatively) has yet to be exploited fully. The possibility of incorporating load cells directly into the lifting apparatus of a fork-lift truck and installing a recorder on the dashboard is perhaps immediately possible. Likewise, load cells and a recorder could be installed in a dump truck, milk truck, oil truck, and many other types of vehicles.

Whether such scales will be evolved in the near future will depend upon several factors. An important aspect to be considered in this respect is the fact that the electronic-scale manufacturers do not stand alone in their efforts to develop better components and techniques.

Actually, such equipment, inherent in the electronic-weighing field, as load cells and, in particular, servomechanisms, also are being used extensively in a great many other fields. Thus chances are that forthcoming improvements in this type of equipment will occur at an accelerated rate and these improvements will lead to rapid advances in the electronic-weighing field as well as in others.

Coal Mining in the USSR

Soviet Drive to Increase Industrial Power Is Based on Expanding Coal Production

By J. D. A. Morrow

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On coal's horizon one development rises above all others. That is the swift expansion of output to make Soviet Russia the largest coal producer on earth next to the United States. Few Americans are aware of the speed and extent of that expansion, or of the accompanying creation of a strong resourceful mining-machinery industry, or of the extent and character of the mechanization of Soviet coal mining. This paper outlines these developments and indicates their significance.

Based on a paper presented at the Joint Fuels Conference of the AIME Coal Division and the ASME Fuels Division, Chicago, Ill., October 29–30, 1953. Slightly condensed.

LONG-WALL mining is the system generally used in producing Soviet coal. According to Russian publications, long-wall mining is employed in the Donets River Basin, called the Donbas, the Moscow Basin mines, and the Kuznetsk field, 2000 miles southeast of Moscow, south and east of the Siberian town of Novosibirsk. The more recently developed Karaganda mines in Kazakhstan are likewise probably long wall, but they may be the scene of room-and-pillar experiments.

Some coal is obtained from stripping operations but no specific information is available as to the extent of such operations or of the tonnage of coal so produced.

Coal, Steel, Electric Production

In Russia, as in Western Europe and America, coal is a major source of energy and industry. Thus the increase of coal output signalizes a roughly corresponding rise in industrial potential. Table 1 presents statistics of coal production in recent years in Soviet Russia and its satellites and in important coal-producing nations of what is called the "free world."

Table 1 Coal Production

(Millions of net U. S. tons)

Country	1928	1938	1940	1947	1948	1949	1950	1951	1952	1955 (Planned)
Western Europe[c]										
Belgium-Luxembourg		33		27	29	31	30	33	34	
France		51		50	48	56	60	58	61	
Saar		16		11	14	16	17	18	18	
Western Germany		153		80	97	116	129	133	136	
Netherlands		15		11	12	13	13	14	14	
Spain		6		12	11	12	12	12	14	
United Kingdom	261	254		221	234	241	242	250	253	
Total		528		412	445	485	503	518	530	
United States	576	374		688	657	484	560	576	502	
Canada		14		16	18	19	19	19	18	
Total		388		704	675	503	579	595	520	
Communist countries:										
Czechoslovakia		18[a]		18[b]	20[c]	19[c]	20[c]	20[c]	22[c]	
Eastern Germany[c]		4		3	3	3	3	3	4	
Hungary		1[c]		1[b]	1[b]	2[b]	2[b]	2[b]	2[b]	
Poland[e]		76		65	77	82	86	90	93	
Russia										
Coal—lignite	43[d]	146[b]	183[b]	173[b]	226[b]	260[b]	291[b]	310[b]	332[b]	416[f]
Peat		(29)	(34)				(51)			(65)
Total		245		260	327	366	402	425	453	

[a] United Nations, Statistical Yearbook, 1949–1950.

[b] U. S. Department of Interior, Bureau of Mines, Minerals Yearbook, 1945, 1951, and 1952.

[c] From United Nations "Economic Survey of Europe Since the War," Geneva, February, 1953, Appendix A, Table VI, p. 244.

[d] Herbert Harris, "Nation's Business," September, 1953, vol. 41, No. 9, p. 75.

[e] *New York Times*, August 23, 1952.

[f] Quarterly Statistics, Iron & Steel Industry in the USSR, Publisher: Statistical Office, West German Republic, Dusseldorf, May, 1953, gives following figures for Russian output (in millions U. S. net tons): 1947, 223; 1948, 249; 1949, 273; 1955 (planned), 450.

Table 1 also reveals the startling fact that in the 25 years from the beginning of the first Five Year Plan to 1952, American and British coal output was stationary, or had declined slightly, while Soviet output in 1952, of 332,000,000 tons, was nearly eight times the 1928 total and was 30 per cent greater than Great Britain's production last year.

In that quarter century and in the postwar period, the rate of Soviet coal expansion far surpasses that of any other important coal-mining country. Furthermore, for 1955 the Soviet rulers plan to push output up to 416,000,000 tons.

Soviet crude-steel production presents a similar picture, rising from 19.4 million tons in 1937, to 38.0 million tons in 1952. The current Five Year Plan provides for 48.7 million tons in 1955. Remember that Hitler's Germany was producing only 25 million tons when he started World War II in 1939 (see Table 2).

Table 2 Production of Crude Steel

(Millions of net U. S. tons)

Country	1938[b]	1947	1948	1949	1950	1951	1952	1955 (Planned)
Belgium	2.5	3.2	4.3	4.2	4.2	5.6	6.5	
Luxembourg	1.5	1.8	2.7	2.5	2.7	3.4	3.3	
France	6.9	6.3	8.0	10.1	9.5	10.8	13.1	
Saar	2.8	0.8	1.3	1.9	2.1	3.0	3.1	
West Germany	19.7	3.4	6.1	10.1	13.3	14.9	17.0	
Netherlands	0.1	0.2	0.4	0.5	0.5	0.6	0.7	
Spain	0.6	0.7	0.7	0.8	0.9	0.9	1.1	
United Kingdom	11.6	14.2	16.7	17.4	18.2	17.5	17.6	
Total	45.7	30.6	40.2	47.5	51.4	57.6	62.4	
United States	28.8	77.0	80.4	70.7	87.8	95.4	93.3	
Canada	1.2	2.7	2.9	2.9	3.1	3.2	3.4	
Total	30.0	79.7	83.3	73.6	90.9	98.6	96.7	
Czechoslovakia	2.5	2.5	2.9	3.0	3.3	3.6	NA[a]	
East Germany	1.8	0.3	0.4	0.7	1.1	1.7	NA[a]	
Hungary	0.7	0.7	0.8	0.9	1.1	1.4	NA[a]	
Poland	2.1	1.7	2.2	2.5	2.8	3.1	NA[a]	
USSR	19.5[c]	14.6[d]	—	—	30.1	34.6	38.0	48.7
Total	26.6	19.8	6.3	7.1	38.4	44.4	38.0	48.7

[a] Not available.
[b] Postwar boundaries.
[c] 1937.
[d] 1946.

SOURCE: United Nations "Economic Survey of Europe Since the War," Geneva, February, 1953, Appendix A, Table VIII, p. 246.

The USSR rate of increase in electric-power production also outstrips that of the Western European nations and the United States, although U. S. total production is still far above the present Soviet total, Table 3.

Thus the increase in industrial potential that might be expected from the development of the Russian coal industry is confirmed by the figures of steel and electric-power production.

Remarkable Postwar Expansion

This expansion of Soviet coal output is more remarkable in view of the vast destruction of Russian productive facilities that accompanied the German invasion, occupation, and retreat.

On the whole, the evidence indicates that Soviet recovery from the devastation of war has been far swifter than that of Western Europe. The Kremlin has offset Marshall Plan aid by drafting manpower, male and female, and working it hard and long, by looting Eastern German factories and laboratories of their machine tools and scientific instruments, and by kidnapping their engineers, plant managers, technicians, and scientists, by stripping the Japanese plants in Manchuria, and by requisitioning what it desired in skilled personnel and machinery from its satellites.

But above all else they made the restoration and expansion of industrial power the first priority of Soviet policy and the first requirement of Soviet life. They indulged in no postwar program to create a "welfare state" that would take care of its citizens from the cradle to the grave. They had no five-day weeks, no "collar-to-collar" mine shifts, no 40-cents-per-ton pension funds, no paid vacations, no annual wage increases, no devotion to time for leisure and cultural pursuits.

They understood that the only way to restore the ravages of war is to go to work—hard—and to keep at it. Further, they knew exactly what they wanted to build upon the wreckage of the last war, and why they wanted it. They have ruthlessly, mercilessly, and unwaveringly regimented and sacrificed the lives of their people to the attainment of that objective, viz., overwhelming economic power. And they understood that its cornerstone is modern, efficient coal mining.

The development of a creative mining-machinery industry, therefore, was a basic necessity in the Soviet long-range plan for their coal-mining expansion. They had foreign machines of many kinds, cutters, loaders, conveyers, drills, and pneumatic picks, British, American, and German, in their mines. They had no regard for patent rights. They began by copying these foreign machines as best they could with their available metals, machine tools, and engineers. But they went on to educate more and better engineers, to improve their metallurgy, to develop a substantial mining-machine industry, and vastly to enlarge machine-tool manufacturing facilities. Furthermore, they had and have unimpeded access to all the patents, the technical and scientific publications, both private and governmental, with all their immeasurable wealth of information, that record the industrial and scientific progress of the Western World. Even before the war they were hard at work designing new and more productive coal-mining machines. For years their main long-range objective was mechanized continuous mining. Consequently, continuous-mining machines, or "combines" as they call them, were high on their list of priorities.

Soviet Continuous-Mining Machines

The following quotations from Russian sources are presented to afford information about these Soviet continuous-mining machines.

According to one article, "the Soviet coal mine has changed beyond recognition."

"Practically all the arduous operations had been mechanized already before the war. And, in recent years Soviet designers, working in co-operation with engineers and miners, have created more than 130 new types of machines.

"Among the new machines which have appeared in Soviet coal mines since the war are coal combines. These splendid machines, which the USSR was the first to produce, simultaneously perform the three principal operations in the mining of coal; cutting (they cut into the coal seam, leaving a slit in it), breaking down (they bring down the coal above the slit, separating it from the solid mass), and piling (they dump the broken-down coal on the conveyer).

"Three coal combines stand out among the different types put out and they are in use more widely than any of the others. These are the 'Donbas,' 'UKT-1,' and 'KKP-1.' Their designers received Stalin prizes.

"These combines are intended for use in working different seams.

"The Soviet coal-mining industry occupies first place in the world for the degree of mechanization of labor."

Note that three different continuous miners, or combines, are mentioned as the most widely used, but many others have been built and tried in Soviet mines, as indicated by articles and pronouncements in Soviet newspapers and journals, with varying degrees of success.

A description of a fourth machine, the UKSH-1 combine, for continuously mining coal in pitching seams, or a similar machine, points out that "it was three tons in weight and had picks 6 to 7 in. in length, fixed into a revolving frame, which slid in sleeves up and down the length of the cutter, shearing the coal in the process, which was then left to fall down the face into a bunker on the lower road." The machine was operating on a 175-yd face on a 45-deg pitch. "It was estimated that a team of four men with this machine could produce 250 tons of coal per day under such conditions, provided the length of face was available." In other words, provided an undisclosed number of additional men on that long-wall face could do the necessary rock ripping and pack work, move and set the necessary jacks, advance and load out the stalls to permit full-shift operation of the combine.

Another type is "a coal cutter with a circumferential jib with picks fitted to two revolving frames with a wormlike arrangement, so as to work the coal toward the edge of the previous cut, after which it slid down the coal face to the loading point." This may have been a Donbas combine.

Another Soviet writer states that the Donbas combine on the average produces in excess of 200 tons per shift from a 12-man crew, or an average of 10 to 12 tons more per man shift than working with an ordinary coal cutter, and states further that it cuts a strip of coal 1.5 meters (4.92 ft) deep.

"Although this Donbas coal-cutting combine looks like ordinary machines, it is quite different. It simultaneously performs all the main jobs: Cuts the seam, hews the coal, and loads it on the transporter belt.

"An operator runs the machine, and his assistant attends the electric cable which feeds it, and changes the teeth of the cutter bar. An electrician watches over the transporter belt and helps the operator. Propmen keep up close behind, erecting temporary metal props as the machine eats its way into the coal vein.

"At the end of the transporter belt, empty coal cars are loaded and then rolled back to be taken away in trains of 30 to 40 cars by an electric locomotive which pulls them to the hoist. The coal is raised to the surface on transporter belts and then loaded onto railway cars. Actually the human hand does not touch the coal from the seam to the railroad car."

But according to remarks from some of the miners themselves, it is found that new Soviet mining machines, as here and elsewhere, are full of "bugs," and in their introduction Russian miners stumble over the same troubles that plague us here—dust, gas, bad roof, rock bands and pyrite inclusions, timbering, and transportation "bottlenecks."

Table 3 Production of Electric Power

(Billions of Kilowatthours)

Country	1938	1947	1948	1949	1950	1951	1952
Belgium[b]	5.3	7.2	7.9	8.2	8.5	9.5	8.3
Luxembourg	0.5	0.4	0.6	0.6	0.7	0.8	0.8
France[c]	18.8	26.7	29.4	30.3	33.6	38.0	38.5
Saar	1.3	1.1	1.2	1.5	1.5	1.7	1.8
West Germany	31.1	25.4	31.5	37.2	42.2	51.4	54.3
Netherlands	3.5	4.4	5.3	6.0	7.0	7.5	7.6
Spain	2.7	6.0	6.1	5.6	6.9	7.9	9.7
United Kingdom[e]	24.4	42.6	46.5	49.1	55.0	60.0	59.0
Total	87.6	113.8	128.5	138.5	155.4	176.8	180.0
United States	113.8	307.4	336.8	345.1	387.9	432.3	462.6
Canada	26.1	43.4	42.4	44.4	48.5	54.8	61.8
Total	139.9	350.8	379.2	389.5	436.4	487.1	524.4
Czechoslovakia	4.1	6.7	7.5	8.3	9.3	10.3	NA[a]
East Germany	17.2	13.3	14.9	17.2	19.0	20.8	NA[a]
Hungary	1.4	1.6	2.0	2.4	2.8	3.3	NA[a]
Poland[d]	7.0	6.6	7.5	8.1	9.4	11.1	11.4
USSR	36.4[f]	49.5[g]	—	—	90.3	103.0	116.4
Total	66.1	77.7	—	—	130.8	148.5	—

[a] Not available.

[b] Total production of public utilities and other plants with an installed capacity of more than 100 kw.

[c] Production of hydroelectric plants with a generating capacity of over 1000 kw and of thermoelectric plants with a capacity of over 5000 kw.

[d] Production of public utilities and other plants with an installed capacity of 1000 kw and over. The prewar Polish figure relates to postwar boundaries.

[e] Public-utility production only. United Kingdom figures exclude Northern Ireland. United States total production in 1939 was 161.3 billion kwhr, of which public utilities was 127.6 billion kwhr.

[f] 1937.

[g] 1946.

Source: United Nations "Economic Survey of Europe Since the War," Geneva, February, 1953, Appendix A, Table VII, p. 245.

Soviet Versus British Machines

Accurate comparisons cannot be made between Soviet long-wall continuous-mining machines and those in use in Great Britain, for lack of detailed information. However, it does seem that the Donbas continuous miner and probably most of the other Soviet machines are built around the principle of cutting enough coal out of the seam so that the weight on the face, or components of the machine, will bring down the rest of the cut and either gravity or the machine itself puts this broken coal onto the face conveyer. This is the general principle used in the British Meco-Moore machine, perfected during the war.

The 100-plus Meco-Moores in use in Britain average about 7 tons per man shift. This may seem small, but it must be remembered that long-wall mining in Great Britain requires much more "dead" work than the American room-and-pillar system. The Meco-Moore is a large machine suitable for use in seams of 4 ft and greater height. It has horizontal cutter bars and a vertical shearing bar running along the back of the cut. The usual width of the cut is 5 ft, practically the same as the Donbas. At the end of the cut, the cutter bars must be reversed, which requires about half a shift and reduces the over-all productivity accordingly. It would be interesting to know how and in what length of time the Donbas is reversed for a return cut, or if it must be retreated to the beginning of the cut to start the next one.

It seems probable that the USSR has not thus far developed long-wall machines and methods superior to

those of the British, Dutch, French, Belgians, and Germans, but it does seem likely that the Russians are introducing their machines into their mines and perhaps making improvements at a faster rate than the Western European nations.

About 60 per cent of subjugated Poland's 93,000,000 annual tons of bituminous coal comes from room-and-pillar mines, equipped with heavy track, powerful electric haulage locomotives, and capacious steel mine cars. Polish and Czechoslovakian mines are using Russian-made copies of the latest types of American cutting machines, loaders, and shuttle cars. In fact, Polish and Czechoslovakian postage stamps bear pictures of Joy-type crawler-mounted loading machines and rubber-tire, wheel-mounted universal cutting machines at work in their coal mines as evidence of communist technological progress in underground mechanization. The output per man shift in Poland is the greatest in Europe and approaches that of many American mechanized mines.

New Machines Planned

In the higher levels of Soviet administration there is vision, determination, and planning for new machines and advanced underground techniques that intrigue our interest and command our attention. USSR First Deputy Minister of the Coal Industry, A. Kuzmich, states that the successful introduction of new equipment and the improved organization of production has made it possible to increase coal output 27.7 per cent in the last three years and raise the productivity of labor by 23.6 per cent. Then he lists vitally urgent problems that remain to be solved in Soviet coal-mine mechanization, among them the following:

1 "Converting advancing to retreating methods of working sectors and mine fields." This arouses speculation as to whether Kuzmich is referring to changing over from long-wall mining to room-and-pillar methods, in consequence of his observation of the Polish productivity. If so, it is especially interesting at this time, when some of the progressive American coal-mining companies are trying out long-wall mining in this country and when the advantages of one method over the other provide an animated subject of international discussion by European and American mining engineers.

2 "Change over old methods of mine management, layout, and operation to the new methods required for efficient mechanized mining."

3 "Develop and introduce continuous tunneling machines." Here Kuzmich says: ". . . . . the new SMB-1 tunneling combines introduced in the Donets Basin mines mechanize all work connected with tunneling except bracing and make it possible to raise tunneling tempos to 2 to $2^1/_2$ times those when loading machines are used. Work is being done to develop new types of tunneling combines for heavy rock strata."

4 "Mechanization of propping." Says Kuzmich on this subject: "Persistent work by Soviet designers and inventors recently has made the solution of this problem quite practical. Tests already have been made of two types of mechanized propping for Donets Basin and Moscow Basin mines. Even with most favorable test results, however, these types of propping will be suitable only under limited mining conditions. The necessity of extensively introducing mechanized pit propping in stopes, as stated in the 19th Party Congress directives, demands that we miners radically increase work to develop mechanized propping for various mining conditions."

5 "Remote control of automatic operation of machinery in mines." On this subject, Kuzmich states, "during the Fourth Five-Year Plan coal-industry workers made the first steps toward the automatic operation of machinery in mines—certain types of equipment for automatic operation were developed, the production base for their mass production was established, and certain designs were put into use. Now thousands of combines, cutting machines, scraper conveyers, pushers, and hoists are operated by remote control in mines and much pumping equipment has been made automatic.

"Under the present five-year plan the transition must be made to remote-control operation, with automatic protection, of combines, cutting and loading machines, and automatic pumping equipment must be more widely used. The use of automatic signals, centralized operation, and blocking in underground transportation of coal mines will be expanded."

6 "Underground hydraulic coal extraction." In this connection he said, "the use of hydraulic engineering methods in coal mines is also in prospect. Technical means for underground hydraulic coal extraction already have been developed. Industrial exploitation of a complex for hydraulic coal extraction began in a Kuznetsk Basin mine at the end of 1952."

It is impossible to say how much is fact and how much is guileful deception in such Soviet statements. Careful screening and consideration of all the known facts and confirming evidence, however, lead to these conclusions:

1 A more rapid expansion of coal production is going on in the USSR than in any other important coal-producing country.

2 Mechanization of mining is probably proceeding at a faster pace there than anywhere else in Europe.

3 The Soviet objective is automatic, remotely controlled, continuous coal mining.

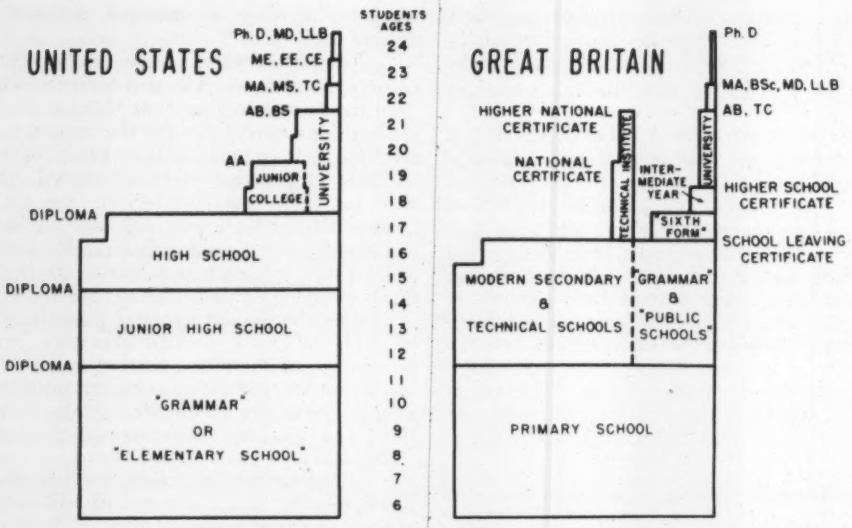
4 This mechanization is based on a well-directed, effectively organized, and rapidly expanding creative mining-machinery industry that, at least in volume of product, probably has no counterpart in Western Europe.

Production Wins Wars

Stalin said, "Production wins wars." So the USSR will have production, will build up industrial power to overwhelm all opposition, at whatever bitter sacrifices imposed upon the subject peoples.

That is the stark significance for us of the rapid increase of Soviet coal production and of the Soviet drive toward the most effective mechanization of their mines that they can devise. It is a necessary step in their purpose, stated and reiterated over and over again, to destroy the capitalist nations, of which the United States is their chief enemy.

How can the western world meet the challenge of the growing USSR mining potential? Automatic continuous mining of coal is and has been the objective of machinery designers and mining engineers in every coal-producing country in the free world. It is the author's conviction that the engineers, designers, and builders of mining machinery in these countries can keep ahead of their Soviet rivals, provided they have freedom of opportunity to exercise their ingenuity and resourcefulness in freely competitive markets.



Diagrammatic comparison of British and American educational systems

A Look at British Technical Training

By W. S. Rouverol

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Academic credentials presented by British technical men seeking employment in American industry or admission to American universities can be a source of considerable confusion. Not only is the nomenclature designating various types of British schools different, but the character of the institutions themselves is sufficiently dissimilar to make direct comparisons with American institutions fairly hazardous. The situation may perhaps be clarified by the accompanying diagram of the British and American educational systems. Some of the important contrasts and comparisons are summarized in the paper.

THE FIRST level at which a significant differentiation in the British and American school systems occurs is at the end of the primary school. At the age of about eleven all British school children are given an aptitude test to determine their educational capabilities. The children with the lower scores go on to "modern secondary" and "technical" schools, corresponding to our regular and polytechnical combined junior high and high schools. Those children who receive the highest scores, on the other hand, are sent on to the "grammar" and "public" schools, where they receive six years of fairly intensive preparation for the university.

Aside from the possibility of injustices in a segregation at such an early age—and there are very real obstacles to gaining admission to a university from a modern secondary or technical school—the training of pre-college students in Britain is thus carried out with considerable efficiency. The accelerated instruction made possible by segregation carries the student through basic courses in language, history, and mathematics that in America are not scheduled until at least the freshman year of college, and in some cases even later.

For example, British students entering a university to take up engineering or science, although about the same age as American high-school graduates, already have completed a thorough course in integral calculus, normally considered in the United States a second-year university subject. In general, it is safe to assume that the British university entrant is academically at least a year ahead of his American counterpart.

Another important difference, indicated on the chart, is that the minimum legal age for leaving school, reached by a few students in both countries before completing secondary training, is one year less in Britain than in most states in this country. This does not apply, however, to students seeking admission to a university, who must remain for an additional year—the so-called "Sixth Form." The work in this grade, as noted, is more or less on a par with freshman-year work at American universities.

Paper delivered before the Fall Conference of the ASME Professional Division, San Francisco, Calif., October 16, 1953.

The "Intermediate" Year

Admission to universities is governed by competitive examinations, which may be taken upon completion of the Sixth Form. What actually has happened in Britain, however, is that so much prestige has come to be attached to the two oldest universities, Oxford and Cambridge, that many students prefer to have a second and even a third try at their entrance examinations rather than attend one of the newer universities. For some students this has meant remaining at least one additional year in the preparatory school, beyond the Sixth Form; others simply spend a year at home studying independently or with a private tutor. The intermediate year has thus become so standard that its completion is now recognized by the awarding of a special diploma, called the "Higher School Certificate," and some universities, including London and one or two others, have instituted Intermediate Year curricula.

The Universities

A number of major differences exist between British and American universities, perhaps the most significant from the standpoint of educational policy being the higher entrance requirements and smaller enrollments at British universities, and the greater degree of specialization in undergraduate curricula. The student-faculty ratios average only 7 or 8 to 1 throughout Britain, as against approximately 16 to 1 in American universities (the range in America being from about 12 to 1 to as high as 30 to 1). The increased personal attention made possible by low student-faculty ratios, the lack of non-technical electives in engineering curricula, the greater selectivity in admission of students, all tend to make possible a more rapid coverage of subject matter. Consequently, the standard material of basic engineering courses is covered in as little as half the time devoted in America. In addition, the circumstances obtaining in British universities permit a somewhat greater emphasis to be placed on mastering fundamentals as opposed to the learning of techniques for treating particular types of problems.

The duration of university courses is in most cases three years, as indicated on the chart. In many fields, however, a distinction is made between a "pass" AB and an "honors" AB, the latter being more difficult and occasionally taking longer. Chemistry, for example, is usually a four-year course. All degrees are granted on the basis of a comprehensive final examination, and although there may be differences in the length of a particular course, the level of accomplishment represented by each type of degree is fairly uniform throughout Britain. This is insured chiefly by the British system of "external" examiners, which requires that at least one faculty member from another university participate in the preparation and grading of the final examinations for every department.

Graduate Schools

Candidates for advanced degrees in Britain are not required to attend lectures, all of the higher academic degrees being granted solely on the basis of original research theses and examinations. The Doctor of Philosophy is awarded by most British universities, but as a fairly recent development, primarily to accommodate American and Commonwealth exchange scholars. Neither the doctorate nor the master's degree is regarded in Britain as a prerequisite for teaching or research positions, largely because courses that would be considered appropriate for master's degree students in America are in Britain included in the undergraduate curricula. Some of the highly specialized courses developed for doctoral candidates at outstanding American graduate schools, on the other hand, are not available at any British university.

The Technical Institutes

While students lacking the special preparatory training of the grammar or public schools have little chance of gaining admission to a university, largely as a result of the lower standards of instruction in the modern secondary and technical schools, they are, nevertheless, not entirely barred from opportunities for higher education. There are in Britain a large number of part and full-time urban colleges, designated variously as National Colleges or Technical Institutes. Courses are offered for both day and evening students, leading to diplomas called "National Certificates" or "Higher National Certificates." While these courses are generally of a more practical or vocational character than most American undergraduate programs, the level of technical training required for the Higher National Certificate in Engineering is more or less equivalent to that for an average American bachelor's degree.

Degrees and Diplomas

A few comparisons between American and British degrees and diplomas already have been indicated, as well as the reasons underlying disparities between apparently equivalent degrees. In general, comparisons must be made with extreme caution, not only because of the inevitable differences in curricular content but because of the wide variations in levels of accomplishment represented by particular degrees as granted by different American universities, all of which may be accredited. With these reservations, it is possible to make a few additional comparisons.

The cumulative effect of the policy of segregation from the age of eleven onward naturally raises the standards of British degrees considerably. There would seem to be little question, for example, that the British honors AB is at least equivalent to the best American MA or MS, or that the "pass" AB is comparable to an average American MA or MS. Similarly, the British BSc, which usually represents a year of research following the AB, is the equivalent of our degree of Engineer. It also is interesting to note that in part because of the greater specialization in the undergraduate years, professional degrees comparable to those awarded by American graduate schools of law, medicine, and education, are obtainable in Britain from one to two years earlier than in the United States. The teaching credential (indicated by the letters TC) is for example available upon completion of an undergraduate curriculum.

Numbers of Students

The width of the various vertical bars on the chart relative to the width of the base is intended to indicate the approximate proportion of students trained to each level. The chart thus reflects the fact that on a per-capita basis, Britain trains about the same number of

skilled professional engineers and scientists as are trained in the United States, if we include in such a category students receiving the British bachelor's and the American master's degrees. There is a considerable disparity, on the other hand, at the level of the American bachelor's degrees, inasmuch as there are, per capita, three times as many American students trained to this level as obtain the Higher National Certificate in Britain. The need for technicians at this level is not so great in Britain, owing to the present lower volume and slower rate of expansion of industrial production. The fact that a similar three-to-one disparity exists in the nontechnical fields probably can be accounted for by a difference in viewpoint as to the proper function of a university.

In Britain and continental Europe the prevailing view is that the purpose of a university is to train scholars and professionals. In America, this would be considered the function rather of a graduate school; the undergraduate program, on the other hand, should be designed to give a broad cultural and vocational background to as many students as possible, even though as many as half of them will not complete the four-year course. This concept of universal (or at least much wider) education at the college level may have developed more rapidly in America in part because of the weaker influence of aristocratic or feudal antecedents; a more important cause, in that it has made wider education a practical possibility, is undoubtedly the relatively great national wealth of the United States. To what extent this national wealth may also be an effect of the volume of education is difficult to say, but the relation would certainly appear to be a reciprocal one.

Conclusion

It is hoped that the foregoing comparisons will afford some clarification in the problem of credential evaluation. In addition, many readers may feel the discussion raises a serious question relating to the training of our most outstanding technical men. Although the levels reached in American graduate engineering schools are comparable to those reached anywhere, the fact remains that they are reached from one to two years later. This results essentially from keeping our most gifted students in what amounts to a sort of "convoy" situation for their entire academic careers up to the time they begin graduate work. Even in the primary schools, the once-common practices of "skipping" some of the brighter children or placing them in "opportunity" classes have gradually succumbed to the educational psychologist's admonitions about social adjustments of children. A glance at the chart reveals that in the American system the only point at which any segregation occurs is at the junior college level; but even this is temporary, in that qualified students may rejoin their university colleagues in the junior year.

It is probably a fact that segregations based on intellectual aptitude are essentially antithetical to American academic traditions. This apparent distrust of segregation, taken together with an equally strong tradition (if not also an economic necessity) of training as many students as possible at all levels, creates the basic problem. It is difficult to see any solution that would not involve increased personal attention for the individual student, which in turn would require much lower student-faculty ratios.

To what extent major increases in secondary school and university teaching staffs could be justified economically would seem to depend on a number of considerations. How much acceleration in the instruction of the more capable students can enlarged staffs achieve? How many of the outstanding students end their education prematurely because of impatience with their own rate of progress, or because of economic necessity? How much could present student-faculty ratios be reduced simply on the income-tax proceeds from university graduates undertaking gainful employment one or two years earlier? How much of the young designer's or researcher's creative energy and imagination is wasted or allowed to atrophy through unduly protracted training? These are some of the questions which would seem to deserve serious consideration before we can afford an unqualified acceptance of our present system of undergraduate technical training.

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British Fellowship Plan

A FELLOWSHIP plan for the practical training in industry of Canadian engineering graduates in Great Britain is discussed by W. Abbott, staff inspector, Ministry of Education, Great Britain, in a paper published in the Proceedings (A) of The Institution of Mechanical Engineers (Great Britain), 1953, vol. 167, no. 3. The plan, now in its third year of operation, is called the Athlone Fellowship Scheme, after a former Governor General of Canada, the Earl of Athlone. It is designed to bring to Great Britain every year 38 Canadian engineering graduates for postgraduate study extending over two years. This two-year period may be spent in industry, in a university, or it may be divided between the two.

The fundamental aim of the Athlone Fellowship Scheme is to familiarize Canadian engineering graduates with British industry. The Fellowships cover: (*a*) the costs of travel from the applicant's home to his place of training, of travel within the United Kingdom, as may be approved, and of the return journey, (*b*) a subsistence allowance, (*c*) the cost of tuition at a university, (*d*) an allowance toward textbooks, and (*e*) a travel grant for journeys within the United Kingdom. Industrial employers are asked to pay into a central fund the wages they would normally pay to a trainee of the college-apprentice type. The net cost of the scheme is carried by the British Government.

The scheme is controlled by a committee, in London, representing the government departments concerned, industry, the universities, and the professional engineering institutions.

There are two classes of award: one, Group A, for those about to graduate, on a quota basis; and the other, Group B, on a national basis, for those who had already graduated and were at work.

According to Mr. Abbott, many factors have a bearing on the future success of the scheme. It is desirable to insure that as many as possible of the Fellows shall enter industry and saturate themselves with workshop techniques and the products thereof. However, the majority of candidates have preferred to continue their studies in a university with a view to securing a higher degree. The plan fits most suitably the requirements of the graduate in mechanical, electrical, or chemical engineering.

Briefing the Record

Abstracts and Comments Based on Current Periodicals and Events

J. J. Jaklitsch, Jr., Associate Editor

Fig. 1 Yoder tube mill for high-speed cold-forming, welding, and sizing of nonferrous tubing. View is from exit end of mill, with part of automatic-saw cutoff at extreme left and sizing mill in center. Welder and part of forming mill is at right.

Cold Roll Forming

A NEW process and the equipment necessary for continuous high-speed cold-forming and welding of nonferrous metals in a completely integrated tube mill has been developed by Yoder Company, Cleveland, Ohio.

Two mills, one for the Bridgeport Brass Company, Bridgeport, Conn., and the other for the Kaiser Aluminum and Chemical Corporation, Trentwood, Wash., have recently been completed. These two mills are designed for making aluminum and other tubing from coiled strip, in sizes from about $^3/_4$ in. × 0.025 in. up to about 4 in. × 0.134 in., at speeds from 40 to 120 fpm, depending on gage and kind and analysis of metal to be welded.

Two more mills, being built for the Aluminum Corporation of America, are to make tubing up to 8 in. in diam and 0.156 in. wall thickness.

The welding is done by high-frequency current introduced through a short inductor coil, through which the cold-formed tube passes without contact. The current travels around the surface of the tube in the region of the inductor, then flows along the converging edges of the unwelded tube, to and from a near-by point of convergence, which is substantially beyond the field of induction and close to the center line of a set of rolls which press the seam edges together.

As the current approaches the point of convergence of the edges, it is, due to the skin effect as well as the proximity effect, confined to a very shallow layer on the surfaces of the two abutting edges.

Practically all the current passes between the edges, at the point of initial contact, where the weld is effected. Little or no shunting current passes across the seam beyond this point, since this would require such current to traverse a path of much higher impedance.

The factors of skin effect, proximity, and reactance effect, are predominant at the frequency employed, which is in the neighborhood of 450 kc. Because of these factors, exceedingly narrow heat-affected weld zones are produced, evidencing high-temperature gradients from the weld interface into the adjoining metal.

The welds are characterized by extremely short time-at-temperature, which is proved by the fact that it is possible with the bare hands to touch the weld in aluminum tubing less than one second after it is made. Because the high-temperature surface is so thin and confined to the edges of the tube, the heat contained in the molten surface layer instantly spreads by conduction into the adjacent tube metal.

Weldable Metals

The weldable materials include almost the entire range of aluminum alloys available in coiled sheet form; certain magnesium alloys; a wide range of brasses and other copper alloys; nickel and nickel alloys, such as monel and inconel; also austenitic and ferritic stainless steels and the lighter gages of carbon steels, the percentage of carbon in the latter being less critical than in electric resistance and the hot processes of welding.

As the heat is confined to a thin surface layer at the edges about to be joined, most of the physical properties acquired through cold-working of the strip metal are retained in the finished tube.

Electric-welded steel tubing is made in lighter gages than heretofore economically available in nonferrous metals. Thus steel tubing is being commercially cold-formed and electric-welded in gages down to 0.020 in., with a limit of 2 per cent applying to the ratio of wall thickness to tube diameter.

In the forming of light gages, it was expected that the great obstacle would be the tendency to wrinkling and

buckling of the edges, because forming techniques in the past have been limited to gages and sizes prevailing in cold-forming steel tubes.

The causes of edge buckling in very light gages were diagnosed as column failures which are confined to the edge portions of the tube blank and are due to residual compressions of these parts of the tube blank.

General Design

All the mills have been standardized and are similar to the mills now completed or being built by the Yoder Company.

In these mills, just as in most resistance-weld mills for steel, the lead end of the strip must first be threaded slowly, with frequent stops, through the forming mill and welder to the sizing mill, before continuity of movement is obtained to achieve consistent welding conditions. Hence the need, where maximum production is desired, for using either large built-up coils, or a looping arrangement for continuous feeding at full speed.

The forming mill is equipped with an entry table embodying felt wipers, pull-over—pull-under rollers, carbide-faced side guides for the stock, and a pair of adjustable-edge trim-cutter holders. The first driven roll stand holds a pair of flat feed rolls for pulling the stock through the edge trim cutter. This is followed by three driven roll stands for mounting the "breakdown rolls" which, in combination with idler rolls between and beyond them, completely form the flat strip approximately into a tubular shape, having quite a gap between the edges at the top, for entry into the first fin pass.

The first pair of idler rolls is of conventional design. Between the second and the third driven breakdown roll stands comes a diagonally mounted cluster of four edge-forming idler rolls, essential to elimination of edge buckling.

Between the third driven roll stand and the first fin pass are two pairs of triple-roll idler clusters for making the critical transition between these stations without danger of buckling.

The three fin-pass roll stands are close-coupled in a single housing of the latest design, substantially as used in Yoder mills for making steel tubes.

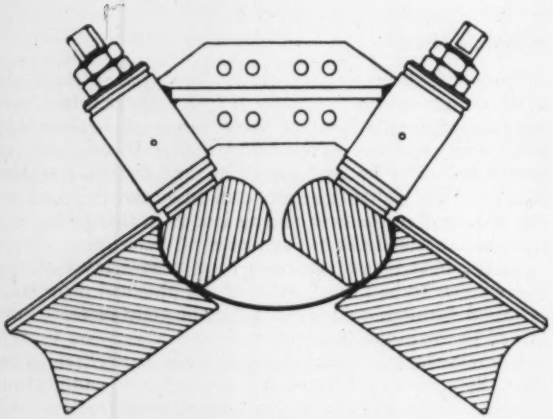


Fig. 2 Schematic drawing of 4-roll idler cluster, focal point in novel system of cold-forming, designed especially for nonferrous tubing. By this system the wall thickness may be as low as one per cent of the tube diameter, but not less than 0.025 in. Small fractional-inch sizes may be drawn from larger sizes.

Fig. 3 Physical test samples of induction-welded tubing. Center piece, *in front;* nickel. Grouped around it, *left to right;* 70-30 brass, 52 SH 32 aluminum, low-carbon steel, and B50 SH 32 aluminum alloy.

The squeeze rolls and their mounting are of novel design, consisting of the holder for a three-roll cluster, the rolls being individually adjustable, while the cluster as a unit is instantly adjustable by means of a star wheel, to obtain the right pressure for welding purposes. The exact pressure is indicated by a strain gage on one of the roll-mounting arms.

The outside welding burr of flash trimmer, as well as the ironing rolls which follow, are of standard design, as used on Yoder resistance welders for steel.

A flying cutoff saw is especially designed for this mill. Other means of automatic cutoff may also be employed, notably the shear-type cutoff press, and the rotary cutoff machine, both of which are extensively used in resistance-weld mills for steel.

The mill drive consists of a variable-voltage generator, excited by a magnetic amplifier which compares forming-mill tachometer voltage with a reference voltage, to hold the mill speed within one half of one per cent of the preset value.

A 50-kw welding oscillator unit takes power for its plate rectifier from a 100-kva, 3-phase alternator set. This is designed to eliminate the effect upon the line of supply-line transients. The alternator likewise is excited by a magnetic amplifier which maintains the plate voltage of the oscillator at any desired level.

The oscillator is cooled by a recirculating water supply whose temperature is maintained above the ambient dew point to prevent condensation. It is ventilated and positively pressurized with filtered air by an external blower to permit trouble-free operation under adverse mill conditions.

Nickel-Cadmium Battery

A STORAGE battery, smaller by at least half than standard batteries, which uses nickel-cadmium cells of a special sintered-plate type, was revealed recently by the Sonotone Corporation, Elmsford, N. Y.

The battery is said to be invulnerable to shock and vibration; eliminates worries about overcharging, reverse charging, or short circuiting; uses an alkaline solution instead of acid; is foolproof to maintain, requir-

ing only a few drops of water a year; and will operate under extremes of temperature as high as 165 F and as low as minus 65 F. The company has for four years turned out more than 600,000 units, all of them for secret military use. The battery has now been freed for commercial usage.

Long life, it was explained, is one of its immediate advantages. Rigid tests indicate a life expectancy of at least five times the ordinary lead battery and in some cases it can be used for 20 years. This longevity will be an important factor in estimating battery costs in the future.

Among its immediate applications are cars, trucks, and buses, railroad locomotives and signaling equipment, Diesel motors, communications, marine motors, aircraft engines, heavy construction and hauling equipment, and all types of farm machinery.

For example, while present auto storage batteries have a life expectancy of about two years, the nickel-cadmium battery will last until an automobile becomes obsolete. In addition, the entire car, including motor, lights, and radio, can be powered by a battery only one third to one half the size of the present unit, it was explained.

Fig. 5 Cell of nickel-cadmium battery, sintered-plate type

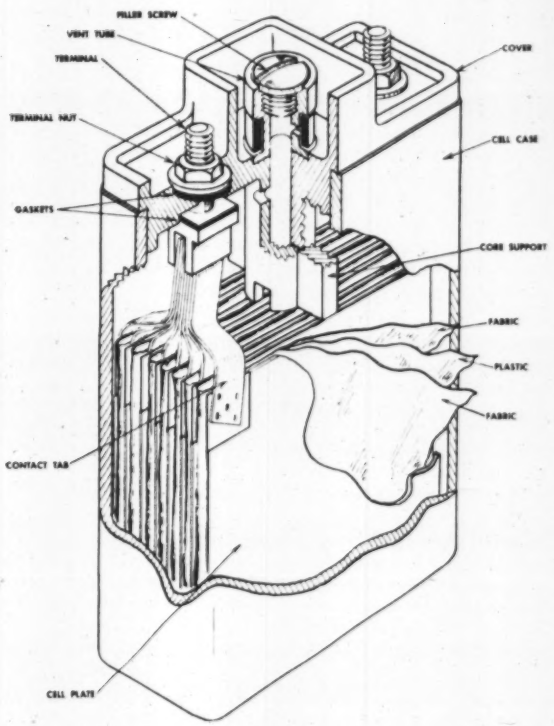


Fig. 4 Each cell of the nickel-cadmium battery consists of a transparent plastic cast, housing a core assembly of positive and negative plates and a separator. The separator takes the form of a multi-ply fabric and plastic sheet interwound among the plates. Connecting tabs extending from each plate are welded to their respective terminals and these terminals are in turn assembled to the plastic cover of the cell. Also, in the cover, there is a vent-plug assembly. The cover, of which the entire core is now an integral part, is cemented in position within the top of the cell case. Thus the cell becomes effectively a sealed unit, except that removal of the vent plug permits addition of electrolyte or the subsequent adjustment of the electrolyte level. When the vent plug is in position in the cover, it acts as a release valve—allowing the escape of gas which may develop during the charging process, but restraining the electrolyte from escaping.

The battery's unique characteristics are due to the special sintering (heat fusing) construction of porous plates. The active forms of nickel and cadmium that convert the battery's plates into positive and negative, respectively, are deposited in microscopic pores electrochemically, providing literally hundreds of square feet of working area. This also produces plates with smooth surfaces, which can be packed together closely with only thin separators.

Because of the battery's all-weather operation, equipment can be left standing overnight or even the entire winter in freezing weather, then will start up immediately at the touch of the starter button. This is a plus value to car owners, farmers, and operators of outdoor equipment in the Northern United States and Canada, who now must install heaters or cover their vehicles.

The electrolyte used is potassium hydroxide, which has a freezing point of approximately minus 75 F. The battery can also be charged at 40 below zero—and at that temperature will accept as much charge as it does at room temperature. The battery, it is claimed, works equally well in tropical climates or in internal usages where high temperatures prevail.

The cells of the battery can be left indefinitely in a state of complete discharge without damage. They also charge at phenomenally high rates. Starting from a completely discharged battery, 90 per cent of the full charge can be reached in less than 20 min and a full charge in a half hour. The battery cannot be damaged by running down excessively high rates of discharge or charge, overcharging, or even reverse charging.

The battery can deliver very large currents in proportion to its size, because of its extremely low internal

resistance. This means new adaptability for hard-to-start motors, such as diesels and airplane engines.

Unique construction features make the battery impervious to shock and vibration—and the cells can be used in any position, including upside down. In rigid tests, the battery has withstood shocks as great as 50 times gravity. The batteries also have been vibrated in each of three directions at frequencies from 50 to 500 cps at 15 times the acceleration of gravity—for several hours—without damage.

Neither gassing nor loss of water presents any problems in heavy usage of the battery. It does not gas on standing or discharge. Under controlled charging conditions, gassing can be reduced to a point where the gas is self-absorbed and reconverted into water. This is particularly important in such usages as submarines, where gassing of lead batteries presents a serious problem.

In other usages, the need to add just a few drops of water a year points to any operation where only limited inspection is desirable or possible, such as telephone relays in remote areas, railway signal lights, and emergency equipment in stand-by radio, TV, radar, and telephone stations.

Sonotone now has battery manufacturing facilities in plants at Elmsford, White Plains, and Port Chester, all in Westchester County, N. Y., plus a factory in Cold Springs, Putnam County, N. Y., built solely for battery manufacture. Although production capacity of these plants still is largely used for military batteries, Sonotone has now allotted research and manufacturing facilities to commercial purposes. In view of the tremendous potential for commercial needs, it has also granted licenses to American Bosch Corporation and Canadian Aviation Electronics, Ltd. They, along with Sonotone, are now prepared to produce the Sonotone battery.

Magnesium Trailer Ramp

A PORTABLE magnesium ramp to facilitate the loading and unloading of highway trailers from flat cars has been developed by Magnesium Company of America, East Chicago, Ind.

The ramp was developed in conjunction with Brandon Equipment Company, Chicago, Ill., to add speed and flexibility to the existing railroad practice of loading trailers over a fixed, permanent ramp onto flat cars. This practice commonly is called "end loading," because all the trailers must pass over this fixed ramp onto the first flat car and then be moved to the next car and so on until the complete string of cars is loaded. A fixed ramp must be located at the end of a stub or dead-end track.

The ramp can be placed in operation at any point along the track where the trailer loading or unloading is being done, at either or each end of the string of flat cars, and at any point where it is desirable to break the string to accommodate a ramp. Thus, the loading time of the cars is said to be sharply reduced.

It is pointed out that the ramp enables the railroad to obtain a high degree of selectivity in picking out the trailers it desires to unload first. This feature certainly will reduce some of the materials-handling problems that rail-trailer freight service has created and will help insure the speeding of freight to the consignees' doors.

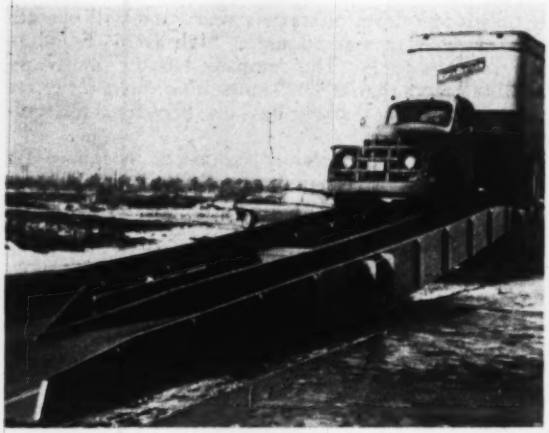


Fig. 6 Magnesium ramp for rail-trailer freight service

The first ramp was placed in service in December by North-Western railway in Milwaukee simultaneously with the inauguration of its overnight rail-highway service between Chicago and Milwaukee.

The ramp, of welded construction, is said to be the largest single unit ever fabricated from magnesium.

The 45-ft-long ramp is 9 ft wide but flares to 11 ft at ground level to permit easy approaches and turns by the trailers. Weighing only 4800 lb, the ramp's capacity is designed to take the heaviest loaded trailer. When positioning the ramp with the flat car, it is raised or lowered by means of a simple manually operated hydraulic system. Anchor stakes fit into pockets on the end of the flat car to secure the ramp.

The ramp moves on rubber-tired wheels and is equipped with a detachable tow bar for attachment to a standard tractor to facilitate its movement in the rail yard.

The use of magnesium permits positioning of this 45-ft ramp by two men. Nine-inch-high curbs on the ramps are designed to prevent runoff and excessive tire wear.

SR-4-Type Testing Machine

A UNIVERSAL testing machine, the Model FGT Baldwin-Emery SR-4 type, having several new features, has been announced by Baldwin-Lima-Hamilton Corporation, Philadelphia, Pa. A machine of 50,000 lb capacity in tension and compression, it is said to be the first production-testing machine in which SR-4 resistance-wire strain gages are used for load measurement. Loads are measured by means of two maximum-precision-type SR-4 load cells of 25,000 lb capacity each, at the base of two vertical tie rods.

When equipped with suitable accessories the machine is capable of testing specimens of structural parts and components not only in tension, compression, and flexure, but also while they are subjected automatically to alternating reversed loads, creep, stress relaxation, torsion, and shock.

With the new load-cycling system it is possible to adjust control points by two load-indicating dial knobs to any two loads between 50,000 lb compression and 50,000 lb tension. Cycling thus may be kept within the tension

range, within the compression range, or between any tensional load and any compressional load.

The rate of cycling depends upon strain amplitude within the machine's speed limits, which are normally 9 ipm up to 10,000 lb load, 4 ipm up to 30,000 lb load, and 2 ipm up to 50,000 lb load. Loads are applied to the bottom platen by a single reversing-power screw from a variable-speed electric motor. Maximum power stroke is 8 in.

The indicator dial on the new model has its zero at the top with 500 divisions plus and 500 divisions minus for indicating compression loads (counterclockwise) and tension loads (clockwise). Four ranges are provided 0–50,000 lb, 0–10,000 lb, 0–2500 lb, and 0–1000 lb. An additional

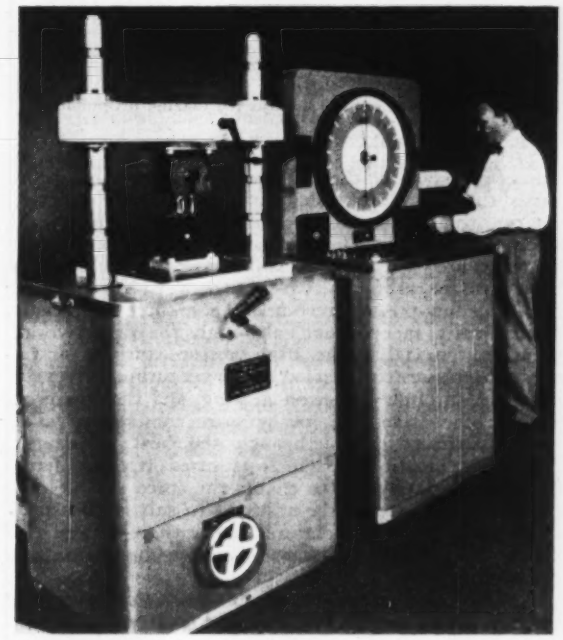


Fig. 7 Recording of stress-strain curves, or the variation of strain as loads are automatically and continually reversed on the test specimen in this new SR-4-Type testing machine controlled entirely by SR-4 strain gages

four ranges are available by use of an SR-4 universal load cell of 500 lb capacity which can be mounted on the crosshead and connected into the main dial indicator. These are 0–500 lb, 0–100 lb, 0–25 lb, and 0–10 lb. In the 10-lb range one scale division represents 0·02 lb.

A strain-cycling system is also provided. It is controlled by means of plus and minus separation of the gage points of an SR-4 extensometer operating through an SR-4-type stress-strain recorder, which is standard equipment. For head-travel cycling, which is distinct from either load or strain cycling, the machine has upper and lower head-motion reversal stations.

Head-motion speed can be held constant at any setting of the speed-control knob, which is calibrated in inches per minute of platen movement between 0.025 ipm and 9 ipm. Constant rates of load application and strain are provided by means of pacing disks. Load pacing is adjustable from dial capacity per minute on any range down to $^1/_{20}$ dial capacity per minute in either direction. Strain pacing is adjustable from 0.00025 to 0.25, in/in/min in either direction.

Load, strain, and platen position can also be held constant by setting cycling controls at zero rate.

A new overload clutch is among the safety devices protecting the machine. This protects the drive motor against exceeding torque rating. Electrical devices protect the weighing system, and limit switches prevent overtravel.

All testing can be done within a single opening of convenient height since load can be applied in two directions. The machine has extreme structural stiffness and lateral rigidity. When loaded to maximum capacity one inch from its vertical axis in any direction, the accuracy of load indications is unchanged. Accuracy is guaranteed within $^1/_2$ per cent of load or 0.1 per cent of scale, whichever is greater. Tolerances on the lowest range are slightly more.

Horizontal clear space between columns is 21 in. and the standard maximum vertical opening between platen and crosshead is 24 in. Working space on the testing-machine table is 20 × 20 in.

The speed of response of the dial pointer while driving the recorder stylus is full scale in any range in 2 sec. High straining rates can be indicated or recorded by use of auxiliary oscilloscopes and oscillographs in external circuits including testing-machine load cells. Since there is no lag in the response of SR-4 devices, high speeds of straining are possible in dynamic testing. This is provided by feeding outputs from load cells and extensometer bridge circuits into the X and Y plates of an oscilloscope through preamplifiers in each line. Persistent screen stress-strain graphs are displayed at such speeds that the duration of the curve development may be as short as 0.01 sec.

The external or load indicator by-pass circuits also may be used to feed bridge outputs to printers, extension-under-load indicators, offset yield-strength indicators, and analog-to-digital converters which in turn will record load and deformation data on automatic typewriters and cardpunchers. All of these accessories are available as extra equipment.

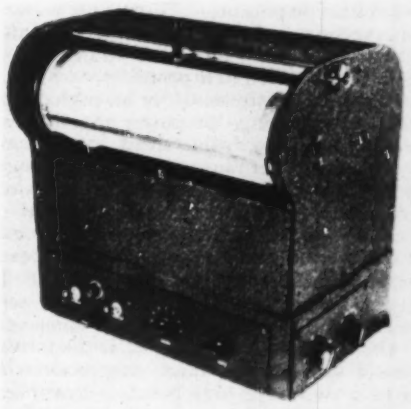


Fig. 8 Model SRA-1 recorder used on model FGT testing machine

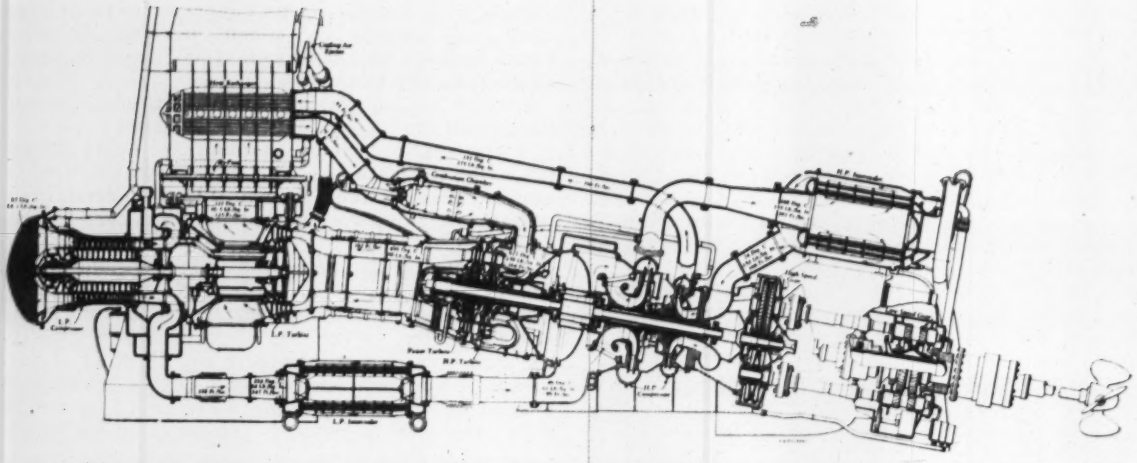


Fig. 9 Longitudinal section through 5400-bhp Rolls Royce R.M. 60 gas-turbine engine suitable for marine propulsion

Marine Gas Turbine

CONSTRUCTIONAL features of a 5400-bhp gas turbine suitable for the propulsion of light high-speed naval vessels are given in the November 27, 1953, issue of *Engineering*. Built by Rolls-Royce Ltd., Derby, England, and known as the R. M. 60, a prototype engine ran for the first time in June, 1951, developing 90 per cent of the design horsepower, which was 6000.

According to *Engineering*, two such engines were intended for installation in H.M.S. Grey Goose, a gunboat of 220 tons displacement, 137 ft 9 in. in length between perpendiculars and of 20-ft beam, originally propelled by two 4000-hp steam turbines giving her a speed of 35 knots. At the time the turbines were built they represented the lightest steam machinery available for naval purposes, having a specific weight of about 14 lb per bhp. The gas turbines, however, will give an increase of 50 per cent in the power developed, with a reduction of 50 per cent in the weight of machinery and a saving of about 25 per cent in the machinery space. This saving has been made possible by making use of the firm's aero-engine experience in the design of many of the gas-turbine components. To provide a convenient means of reversing, and to facilitate the handling of the ship at low speeds, each turbine is arranged to drive a variable and reversible-pitch propeller.

To satisfy naval requirements for an engine capable of developing a wide range of power together with an economical low-power cruising speed, a compound cycle was selected, the power range requirement being met by using both low and high-pressure compression with intercooling between the stages. Economical cruising is achieved by careful matching of the low and high-pressure compressors and also by using a heat exchanger to conserve the heat in the exhaust gases. To give flexibility and ease of handling, the power turbine is made mechanically independent of the compressor turbines. Air, which enters the engine at the forward end, first enters a low-pressure axial compressor which delivers it to a two-stage high-pressure centrifugal compressor, sea-water cooled intercoolers being located in the duct between the low-pressure and high-pressure compressors and between the two stages of the latter. From the second stage of the high-pressure compressor air is passed through a heat exchanger in the exhaust outlet to the two combustion chambers into which the fuel is injected and burned. The hot gases from the combustion chambers are passed in succession through a single-stage high-pressure turbine, a two-stage power turbine, and a two-stage low-pressure turbine. These three turbines are mechanically independent, although the first two of them are coaxial. The high-pressure turbine drives the high-pressure compressor, the power turbine drives the propeller through reduction gearing, and the low-pressure turbine drives the low-pressure compressor. The turbine exhaust passes through the heat exchanger, previously mentioned, which is fitted with a hand-operated by-pass valve to enable the speed of the low-pressure compressor to be adjusted to suit air densities corresponding to temperatures lower than that of the standard tropical atmosphere for which the engine was designed.

Because of the narrow beam and restricted headroom in the Grey Goose it was necessary to design the engines in a long and narrow form. The length of the engine is approximately 30 ft and it was therefore necessary to allow for the twisting and deflection of the hull. This was accomplished by dividing each engine into two basic units connected only by flexible-jointed ducting. To avoid excessive losses in the high-temperature ducting between the turbines the shafting of the power turbine passes through the rotor bores of the high-pressure turbine and compressor, there being no mechanical interconnection between these units except for roller intershaft bearings. The power shaft line of the engine is raked at an angle of 9 deg relative to the axes of the low-pressure turbine and compressor. Three fabricated-steel mounting frames are used; one to carry the high-pressure unit and reduction gearing and the other two to support the low-pressure unit and the heat exchanger, respectively. The mounting frames for the high-pressure and low-pressure units rest on two parallel ship's longitudinal structural members which occupy the full length of the engine room. The high-pressure intercooler is carried on the high-pressure unit mounting frame, the low-pressure intercoolers being mounted independently on the ship's structure. The engine is a self-contained

power unit embodying everything necessary for running, excepting the main fuel tanks, the oil-supply system, the sea-water system, and the electrical supply for starting and motoring. The total weight of the engine, excluding the propeller and shafting, is 13 tons and the full power rating, with an ambient temperature of 15 C of the air and the sea water supplied to the intercoolers, is 5400 bhp.

Atomic Waste Heating

LARGE quantities of waste heat developed in atomic reactors at the Hanford plutonium-producing plant at Richland, Wash., shortly will be used for the first time in this country for heating buildings, according to the General Electric Company.

This practical industrial use of the excess heat will be achieved by indirectly using water carrying away reactor heat to warm the air drawn into certain Hanford plant structures now under construction.

The system was designed by engineers of General Electric Company, which operates Hanford for the AEC and Charles T. Main, Inc., Boston, Mass. Actually, several buildings will be heated by one system, but about half the heat will go into the main structure housing a production reactor now under construction.

Enough heat to take care of the needs of a thousand average-sized homes will be extracted from the reactor-cooling water and transferred to the air going through plant air conditioners.

The initial investment for the heat-recovery system is estimated at about $614,000, and an annual operating cost, excluding repairs, at about $2200. The estimated fuel saving of $59,000 a year would pay off in 7.5 years the $444,000 of the initial cost of the heat-recovery system that would be additional to the cost of a conventional steam system.

How Atomic Heating System Operates

The system will work as follows:

Water from the Columbia River is pumped through the great Hanford Reactors where plutonium is made by the transmission of uranium. The water absorbs immense quantities of heat generated by the process; on its trip through the reactor, dissolved mineral matter in the water becomes slightly radioactive.

Because of this factor, the water from the reactor will be run through a heat exchanger to warm up the water in a secondary piped circuit that will relay the heat to an air-conditioning system in the building, while the radioactive water is carried away. This activity quickly dies away by nautral decay, but the concentration of large volumes would create a radioactivity hazard to the plant areas before being harmlessly dissipated in the main stream of the Columbia.

To prevent the movement of contaminated dust particles from the reactor to working areas, a constant flow of air is maintained across the reactors to the outside.

Consequently, no air is reheated and recirculated in the building. Instead, a large volume of air per minute is pumped from the outside, cleaned, heated, and poured into the building.

To pipe the water directly from the reactor through coils in the floor or walls to warm the building by radiant heat would be impractical because of this large volume of fresh air constantly moving in.

Elements of Heating System

The heating system itself is simple in both concept and in execution. It consists of three major elements connected by an appropriate system of piping. First, the primary exchanger, which transfers heat from the effluent stream to an intermediate fluid; second, the secondary exchangers, which transfer heat from this intermediate fluid to the air; and third, a by-pass exchanger, which is arranged to provide adequate heating when the reactor process is shut down.

The by-pass exchanger is supplied with steam from a central-station plant when called on to perform. The primary purposes of the steam plant is to supply emergency electrical energy to the plant in the event of a power outage. No extra capacity for heating is considered in installing the steam generators.

A network of piping connects the various process buildings with the primary heat exchanger. This piping is all subsurface and is not insulated, as the primary heat source is both abundant enough and at sufficiently low temperature so that losses to the ground will be considered negligible.

This heat-recovery system will answer the question of scores of engineers throughout the nation who have hoped for some economic use of this large energy source. Since September, 1944, the huge reactor process plants at Hanford have been pouring vast quantities of waste heat into the Columbia. This heat, a necessary by-product of the nuclear reactions involved in converting uranium to fissionable plutonium, has been of great interest to engineers, who have looked forward to its industrial application.

Anthracite Mining Method

How a mining method called "induced caving" can, under suitable conditions, improve safety, boost production rates and recovery, and lower costs of mining steeply pitching anthracite beds is described in a recently released Bureau of Mines report. The method, adapted from one long used in metal mines, is one of several being investigated in an attempt to reduce mining costs and aid the anthracite industry.

The Bureau's report describes co-operative tests at a colliery in the southern anthracite field of Pennsylvania. Tests were conducted in a nearly vertical coal bed 14 ft thick. During the experiment, more than 50,000 tons of coal was mined from a block 328 ft high without a lost-time accident.

Induced caving takes advantage of gravity and other natural forces to extract coal from steeply pitching anthracite beds with a minimum of blasting. By removing the bottom of a block of coal first, a void is created which allows the rest of the block to cave naturally.

The procedure is as follows: From a tunnel in rock beneath the coal bed, chutes are driven upward through layers of rock to the bottom of the coal block being mined. From the top of these rock chutes, slanting chutes are driven right and left at 35-deg angles into the coal. The coal between the adjacent rock chutes is blasted and removed. The rest of the block then caves

by natural forces, and the coal is drawn off through the rock chutes.

The Bureau found that induced caving increases safety and at the same time reduces costs by eliminating long slant chutes and the need for carrying timber and supplies up them, by reducing blasting, by concentrating working areas, and permitting closer supervision and control. Dilution of coal by rock from mined and caved areas above the experimental section was the most serious difficulty encountered in the tests. Further research on this problem is under way.

According to the report, nearly twice as much coal can be produced per shift from a given working area by induced caving as by conventional mining methods. The co-operating company has continued to use the method in the test area and is following it in two other sections of the mine.

The Bureau's report describes the tests and their results fully, giving details on geology of the coal measures, development, undercutting and caving, ventilation, and subsidence. Nineteen illustrations and three tables supplement the text.

A free copy of Report of Investigations 5013, "Anthracite Mechanical-Mining Investigations Progress Report 5: Recovery of Anthracite in a Steeply Pitching Bed by Induced Caving," can be obtained from the Bureau of Mines, Publication Distribution Section, 4800 Forbes St., Pittsburgh 13, Pa.

Pressure-Vessel Plant

THE FORMING of pressure vessels of the unusual proportions required for the higher pressures demanded by various industries calls for modern fabricating tools and special and unique equipment. To meet this need, Foster Wheeler Corporation has begun limited operations at a new plant in Mountaintop near Wilkes-Barre, Pa.

This $5 million plant will turn out pressure vessels of varying proportions, including some of the largest and heaviest in demand.

8000-Ton Hydraulic Beam Press

A recent visit to the new plant revealed that among its major tools will be an 8000-ton hydraulic beam press weighing over 3 million lb and said to have an effectiveness in bending steel plate—hot or cold—seldom before equaled. Largest of its type yet made, the press is capable of bending plate 8 in. thick and (in the case of lighter plate) 40 ft long into half-shells which, when welded together, will form extremely large-size pressure vessels. It was built by Baldwin-Lima-Hamilton of Philadelphia, Pa.

Using the simplest type of circuit, control of the speed of the moving beam is at the discretion of one operator. This is effected by a mechanical linkage between the operator's lever and four Oilgear pumps, of the reversing type, coupled to two 200-hp double-end motors.

Actually, the structure combines two four-column presses in one, each with a capacity of 4000 tons. The two sets of columns are coupled together by laminated steel beams—one set attached to the bottom platen and one to the moving platen—to form a single unit capable of exerting loads up to 8000 tons on the plate to be formed.

Each of the 4000-ton sections consists, essentially, of a cast-steel main cylinder, moving platen, pushback cylinders, and equalizer cylinders. The columns are shoulderless and of a straight-through design that permits removal of any one of them without completely dismantling the press. The steel columns are assembled to the main cylinder by means of split cast-steel nuts at the lower extremities and split-steel collars set into a counterbore in the upper surface of the bottom platens. In this way, any of the columns may be removed by drawing them up through the main cylinder column husks.

The presses are designed to provide daylight of 96 in. maximum between the lower surface of the upper bending

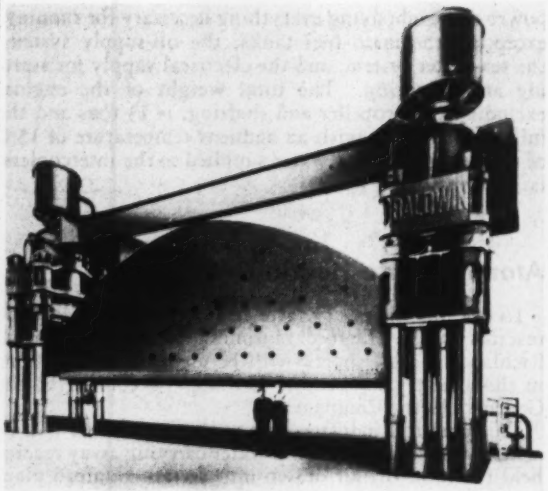


Fig. 10 8000-ton hydraulic beam press, capable of bending steel plate 8 in. thick

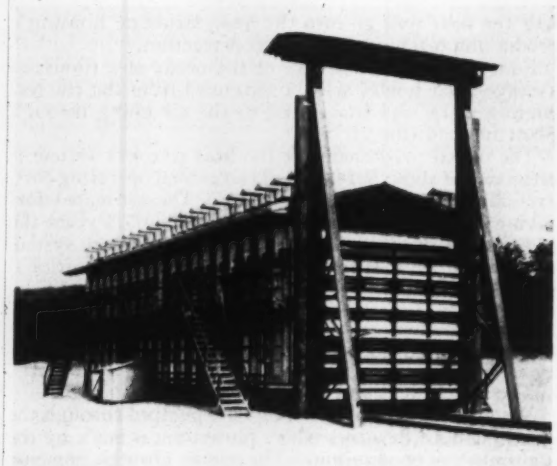


Fig. 11 Pressure vessels at Foster Wheeler's Mountaintop, Pa., plant are stress-relieved in this heat-treating furnace, equipped with 80 burners of Foster Wheeler design, its propane gas firing provides maximum furnace temperatures of 2100 F. One of the largest in use, its interior dimensions, 15 ft wide, 14½ ft high, and 83½ ft long, will accommodate the large vessels to be produced at the plant. An expandable rear wall permits the treating of even larger vessels than 83½ ft.

beam and the upper surface of the lower bending beam. All rams have a maximum stroke of 60 in. Maximum operating speed under no-load conditions, up or down, is 82 ipm; maximum pressing speed is 12 ipm up to 8000 tons.

To facilitate handling of the hot steel plate, there is also a unique plate-handling device which positions the plate to be formed, easily and with minimum loss of metal temperature. Especially designed by Baldwin-Lima-Hamilton, the plate joggling mechanism will handle plates up to 40 tons each. It consists of four 7-in-diam lift cylinders, eight $3^1/_4$-in-diam manipulating cylinders, rollers, push rods, and pins. The push rods are hinged for back-and-forth movement on a vertical plane. Vertical stroke of these rods is $13^1/_4$ in. The lifting pins have a horizontal movement of 3 in. to either side of the vertical center line. The positioning toggles, hydraulically operated, are built into the lower press beam. A 7-gpm, 2000 psi, Vicker's pump, directly coupled to a $7^1/_2$ hp motor, operates the device.

The entire press occupies a surface area 65 × 20 ft. Its 60-ft height is distributed above floor level (38 ft) and below, in a 22-ft pit. To support its 3-million-lb weight, the foundation on which it rests required 750 cu yd of reinforced concrete; beneath this foundation is bedrock.

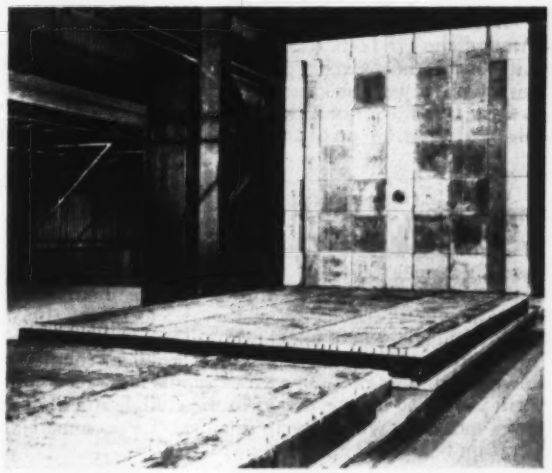


Fig. 12 Flatcars lined with firebrick, and designed to carry a 200-ton load, are used to haul the heavy steel cylinders to stress-relieving furnace. Note the rear wall of the furnace, which is mounted on the car, permitting easy extension of the furnace for extremely long vessels.

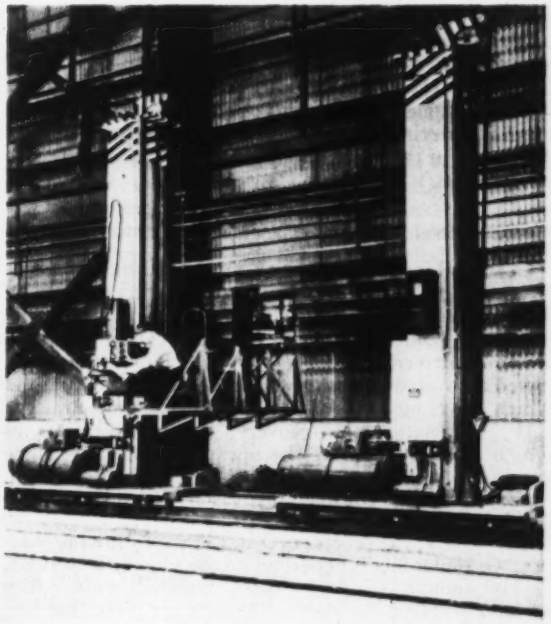


Fig. 13 Automatic shielded twin-arc welding machines

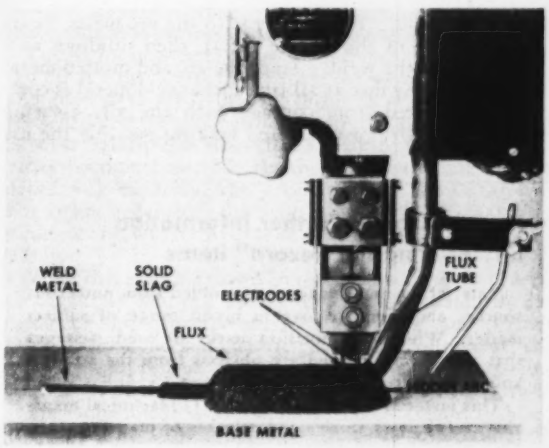


Fig. 14 Details of type LAF, automatic flux recovery twin-arc welding machine. Welders of this type are capable of welding plate 8 in. thick and operate at considerably greater speeds than single-wire machines.

Two Million Volt X-Ray Generator

Another outstanding tool will be a 2 million volt Van de Graaff x-ray generator capable of penetrating steel 12 in. thick. The machine will photograph weld metal with unprecedented clarity of detail, exposing any minute flaws that may occur in the metal. Using fewer and shorter exposures, it will perform its work in considerably less time than conventional x-ray equipment. The Foster Wheeler unit, it is said, will be the first application of super-voltage x ray in private industry.

Special Tools

Other special tools that will make up the new plant, although basically similar to many used in other steel fabricating plants, include the following:

A new system of automatic shielded arc welding whereby vessels may be welded at much greater speeds.

A series of mobile, high-speed radial drills that may be stationed anywhere along a 230-ft stretch of raised track. The drums to be drilled may be placed on either or both sides of the drill platform. The arrangement makes pos-

sible the use in combination of as many as six drills on a single cylinder. (Considering that the length of drilling time required in special operations may represent up to 25 per cent of total fabrication time, it is apparent that a drill arrangement such as this one would result in a substantial lowering of drilling time and also permit better utilization of the tools, regardless of the size of vessels to be processed.)

Automatic Shielded Twin-Arc Welding

Of special interest is the new automatic shielded twin-arc welding process which was built to specifications by Cecil Peck Company and Lincoln Electric Company, Cleveland, Ohio. These automatic welding machines are power-driven and rest on bases which can be raised or lowered to accommodate vessels up to 12 ft diam and which travel on a track 150 ft long. The units are type LAF, automatic flux recovery, power-driven booms which are controlled at the operator's station. These automatic welders are capable of welding plate 8 in. thick at speeds considerably faster than single-wire welders.

Essentially, the process operates in the following manner: Granular flux is deposited on the joint to be welded, deeply enough to cover the completed weld. Bare metallic welding electrodes in tandem are power-fed into the blanket of flux at rates of feed controlled automatically for proper arc length. Direct current produces the hidden arc between the electrodes and the joint. The resultant arc heat fuses electrodes and parent metal, producing the weld. Flux adjacent to the arc melts, floats on the surface of the molten metal, then solidifies as a slag on top of the weld. Since the arc and molten metal are blanketed by flux at all times, the weld metal is completely protected from contact with the air, assuring maximum quality of welds and making possible the use of extremely high amperage for faster welding and lower costs.

While there is little difference in quality of weld obtained between a-c and d-c welding, the d-c system was chosen because of the unique Foster Wheeler arrangement whereby the entire welding unit travels over the length of the 150-ft track. Being lighter, the d-c unit has the advantage of eliminating bulky transformers which would have to travel with the welder along the track.

Contact with power source is obtained by a hidden track below the floor similar to the third rail used for electric trains. Power consumed by one of the welding units is approximately 50 kw.

In the case of welding circular seams, the portable welding machine is held in one position and the drum revolved by means of power rolls.

In addition to the automatic machines, portable welding machines, both d-c and a-c, are used.

Among the products to be fabricated are such varied equipment as heat exchangers for nuclear power; sections of oil towers and pressure vessels weighing over 100 tons; and equipment for jet-engine regenerators, some of it weighing up to 140 tons.

How to Obtain Further Information on "Briefing the Record" Items

Material for these pages is assembled from numerous sources and aims to cover a broad range of subject matter. While few quotation marks are used, passages that are directly quoted are obvious from the context, and credit to original sources is given.

This material is abstracted from: (1) technical magazines; (2) news stories and releases of manufacturers, Government agencies, and other institutions; and (3) ASME technical papers not preprinted for meetings. Abstracts of ASME preprints will be found in the "ASME Technical Digest" section.

For the texts from which the abstracts of the "Briefing the Record" section are prepared, the reader is referred to the original sources; i.e. (1) The technical magazine mentioned in the abstract, which is on file in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y., and other libraries. (2) The manufacturer, Government agency, or other institution referred to in the abstract. (3) The Engineering Societies Library for ASME papers not preprinted for meetings. Only the original manuscripts of these papers are available. Photostat copies may be purchased from the Library at usual rates, 40 cents per page.

Electric Power Supply

THE TOTAL generating capability of the nation's electric power systems at the end of 1953 was indicated to be about 93,000,000 kw, according to the Fourteenth Semi-Annual Electric Power Survey, October, 1953. The estimate is based upon median hydro conditions. This figure is 1,800,000 kw, or 2 per cent less than was shown by returns of the previous semiannual survey in April, 1953, and reflects delays in the completion of new power projects which were planned for commercial operation before the end of the year.

The report, carried out by the Electric Power Survey Committee of the Edison Electric Institute, was made in co-operation with representatives of the electric power systems, or power areas, throughout the United States and representatives of the nation's principal manufacturers of heavy electric power equipment.

The October survey shows estimated total generating capabilities at the end of 1954, 1955, and 1956 which are about 1 per cent less than corresponding estimates given in the April survey report. The estimated capability at the end of 1956 is approximately 124,300,000 kw, as against 125,500,000 kw indicated at the time of the April survey.

The December, 1953, peak load for the country as a whole was estimated as approximately 82,100,000 kw, or about 1 per cent less than the estimate of last April. Indications of the slowing down of industrial activity give rise to this change in the estimate. Similarly, peak-load forecasts for 1954, 1955, and 1956 have decreased about 1 per cent, bringing the 1956 peak load estimate to approximately 105,900,000 kw, compared with the April estimate of 106,600,000 kw.

The combined effect of these changes in the estimates of peak capability and peak loads makes comparatively little difference in the gross margins for the country as a whole. The values fall between 13.4 and 18.7 per cent for the period covered.

The announced schedule of expansion of generating facilities covered by equipment orders placed up to October 1, 1953, calls for 42,500,000 kw of new capacity

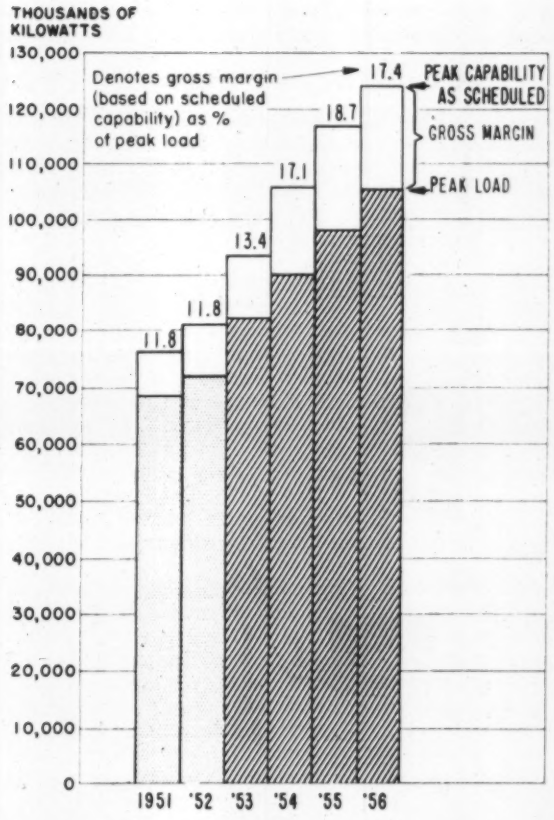


Fig. 15 Total U. S. December peak capabilities and peak loads, 1951 through 1956—median hydro conditions. Peak capability represents the maximum kilowatt output with all power sources available. It must, therefore, provide the necessary allowance for maintenance, emergency outages, and system operating requirements. Gross margin includes the provision for maintenance, emergency outages, and system operating requirements. Any remainder, after these needs are met, is available for unforeseen loads. Capabilities and gross margins for 1953 and beyond do not reflect delays which may result from earlier lack of materials for equipment manufacture and plant construction.

to be placed in service during the four-year period 1953 through 1956. Of this amount, 11,400,000 kw is in the schedule for 1953, about 14,000,000 kw for 1954, almost 11,000,000 kw for 1955, and over 6,100,000 kw for 1956. The schedule for 1956 is not complete.

Construction Progress Impeded

Of the 11,400,000 kw in the 1953 program, about 5,500,000 kw was placed in service during the first nine months of the year, leaving a slightly larger amount still scheduled for operation during the last three months. Adverse effects of earlier material shortages, together with construction labor difficulties encountered in certain parts of the country during the year, have severely impeded construction progress. Strenuous efforts are being made to avoid further loss of time, but it is doubtful that these efforts, in all instances, will be successful in bringing the new projects into service according to schedule.

The present schedule for bringing 14,000,000 kw of new capacity into service in 1954 followed by an additional 11,000,000 kw in 1955 is indeed a major undertaking. It has been geared to the rapid increases in electric power requirements as forecast following the outbreak of the Korean War.

There appears to be some question as to whether it is possible to carry out such an enormous program according to existing schedules. If existing signs of the probable slackening in the general business and industrial activities persist, and if loads in the period just ahead fail to develop as rapidly as now estimated, it is likely that the program for late 1955 and 1956 may be rescheduled over a somewhat longer period.

Electric Generating Equipment

With the greatly improved material supply situation, the manufacture of electric generating equipment has reached an all-time high. The aggregate capacity of thermal and hydraulic generating units shipped to all classes of customers during the first nine months of 1953 closely approaches the total capacity shipped during the entire year of 1952 and far exceeds the total for 1951. The total capacity scheduled for shipment during 1953 is approximately 13,500,000 kw, of which 70 per cent was shipped up to October 1.

The production of other classes of heavy equipment covered by the survey also has benefited by the improvement in material supplies and is proceeding in a satisfactory manner. Some procurement problems still remain, but in most instances they are not critical.

Orders for new heavy power equipment have been falling off at a rapid rate and, except for power transformers and generators for hydraulic turbines, additional capacity scheduled for production during the past six months is substantially less than that scheduled during the previous six-month period. In the case of thermal electric generating capacity, the drop is about 4,800,000 kw. For steam generators the drop is about 15,000,000 lb of steam per hr, and for hydraulic turbines it is about 1,300,000 hp.

With this slowing down in rate of placing new orders, the capacity shipped during the past six months exceeds the new capacity ordered during the same period. In the case of thermal electric generating equipment, the capacity shipped is almost double the new capacity booked. For steam generators the ratio is almost 4 to 1.

The scheduled production of large steam turbine-generators in 1954 (13,500,000 kw) is approximately equal to the estimated full manufacturing capacity. Open manufacturing capacity for the delivery of additional equipment in 1955, over and above that already scheduled, is estimated as about 3,000,000 kw. For 1956 the estimated open manufacturing capacity is approximately 12,000,000 kw. These estimates are based upon extra-shift work schedules and the six-day work week now in effect.

There is considerable open manufacturing capacity in 1954 for the production of steam generators (based upon drum shipments) and close to the full manufacturing capacity is available in 1955. Because of the greatly reduced backlog of work, manufacturers of steam generators are especially anxious for new bookings to avoid loss of manufacturing time and the need for large reductions in shop forces that have been built up to handle the current heavy production schedules. It has been

brought out that with the increasing capacity and complicated design of modern steam generators, particularly for reheat installations, more time should be allowed in the construction schedule for field erection. This points to the need for placing orders further in advance of scheduled dates of commercial operation of new power projects.

Open manufacturing capacity for the production of generators for hydraulic turbines is estimated as 1,200,000 kw for 1955 and 2,600,000 for 1956. For hydraulic turbines, estimated open manufacturing capacity for 1955 is 1,500,000 hp and for 1956, 2,700,000 hp.

The scheduled production of power transformers in 1953 reached an all-time high of 55,500,000 kva. Although the scheduled production for 1954 exceeds 51,000,000 kva, there is still estimated open manufacturing capacity of 10,000,000 kva available for small and medium-size units. Scheduled production in 1955 is almost 21,000,000 kva, with estimated open capacity of 51,000,000 kva. It is significant to note in connection with these estimates of open manufacturing capacity that time required for manufacture and delivery of very large-size power transformers is considerable. In general, it may be said that power transformers to serve very large electric generating units should be ordered about the same time as the generating units.

The complete report, EEI Publication No. 53-17, published in December, 1953, is available at 75 cents per copy from Edison Electric Institute, 420 Lexington Avenue, New York 17, N. Y.

Xerography

A NEW method, as different from letterpress, lithography, or gravure as they differ among themselves, has been added to the graphic arts. This new process, called "xerography," was invented by Chester F. Carlson, in 1938, and is described by William T. Reid in the November, 1953, issue of the *Battelle Technical Review*, published by Battelle Memorial Institute. The method is based entirely on physical and electrical phenomena. In its commonest form xerography is a completely dry photographic process, utilizing a unique type of plate not destroyed by exposure to light. Hundreds of images can be made from a single plate. It is a direct process which produces positive-to-positive prints, but negative-to-positive prints can be made if desired. Another form of the process, known as "xeroprinting," uses a plate not sensitive to light, and from which printing has been done in the laboratory at web speeds as high as 1200 fpm. Because of its immediate commercial importance, xerography has been developed most intensively.

Battelle Development Corporation, a wholly owned, nonprofit subsidiary of Battelle, entered into an agreement with Carlson in 1944 whereby Battelle undertook research and development on xerography in its own laboratories. By 1947 the results obtained were so spectacular that The Haloid Company of Rochester, N. Y., entered into a license arrangement to commercialize the process. Since then, Government agencies, including the Signal Corps, the Air Force, the Ordnance Ammunition Center, and the Engineer Research and Development Laboratories have joined with Haloid and Battelle in research on different phases of xerography. The rate of effort possible from such a wide sponsorship of research has resulted in outstanding advances in xerography during the past five years.

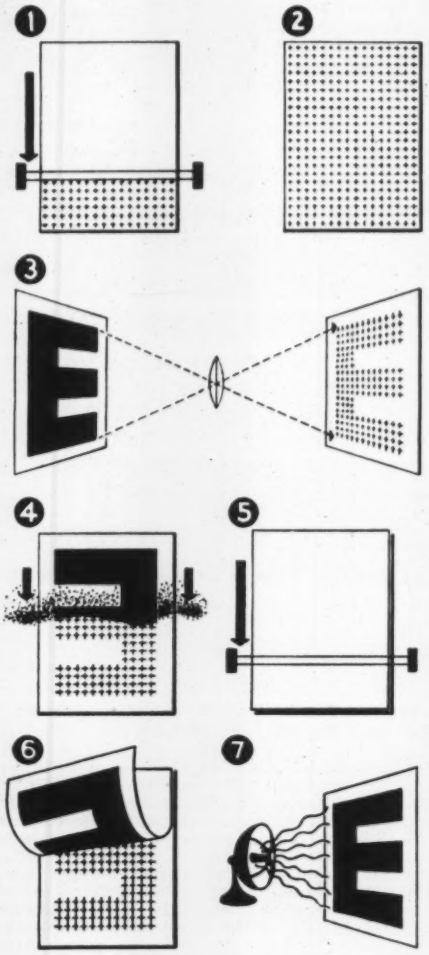


Fig. 16 Important steps in the xerographic process: 1, The surface of the specially coated metal plate is electrically charged. 2, The entire plate coating is positively charged. 3, The copy is projected through the lens in the camera. The plus marks show the projected image with positive charges. Charges disappear in areas exposed to light. 4, Negatively charged powder is applied, adhering to the positively charged image. 5, After powder treatment, a sheet of paper is placed over the plate and receives a positive charge. 6, The positively charged paper attracts the powder from the plate, forming a positive image. 7, The print is then heated to fuse the powder and form a permanent image.

How Xerography Operates

Basically, xerography depends on: (1) The formation of an electrostatic image on an insulated photoconductive surface by exposure to light; (2) the development of this "latent" image by a finely divided powder; (3) the transfer of this powder image to a permanent support such as a sheet of paper; and (4) fixing the image to that sheet, as by moderate heating.

Although xerographic plates have been made from

many photoconductive materials, vitreous selenium is the preferred material at present. In making xerographic plates, specially purified selenium is vacuum-deposited under closely controlled conditions on metal plates, such as aluminum. Selenium films, properly prepared, have the unique property of high electrical resistance in the dark and relatively low electrical resistance when illuminated. Thus a light image can produce electrical changes in a plate which can then be made to form visible images by development with a dry powder. Xerographic plates of high quality are now being made commercially on a large scale.

Xerographic plates are sensitized by charging their surface to a potential of several hundred volts by spraying them with ions formed by a corona discharge. Although the voltage necessary to produce this corona discharge is high, the current is low and no danger exists to the operator. Several techniques have been devised to control the voltage accepted by the plate. Because of the high specific dark resistance of the selenium film on the plate, about 10 ohm-cm, the potential on the plate leaks off only slowly in the dark. Thus the plates can stand and be used many hours after sensitization if necessary. Normally, plates are sensitized immediately before use.

Exposure of the sensitized plate is done by conventional methods, either by contact or in a camera. Usually a camera is preferred because it permits reproduction of material printed on both sides and permits making the copy either larger or smaller than the original. Exposures are short. The photographic speed of the commercial plate is about ASA 2, or approximately the same as process film with tungsten illumination. During exposure, the uniform charge on the surface of the plate leaks through the photoconductive selenium film in the illuminated areas. The dark areas of the image, the unexposed areas of the plate, retain their charge, thereby producing a latent electrostatic image.

This electrostatic image is developed by a finely divided powder, either poured over the surface of the plate or applied to the plate in the form of a cloud. The particles of powder must carry an electrostatic charge of polarity opposite from the surface of the plate for the powder to be attracted to the image areas. To provide this charge for bulk powders over the surface of the plate, known as cascade development, the powders are mixed with a granular material. This carrier material is so chosen that triboelectric, or surface electrification, effects produce the proper electrical charge on the powder when two are separated. Thus, when the carrier-powder mixture is cascaded over the plate, the powder leaves the carrier with an electrical charge that causes it to stick to the plate only where some voltage still exists. Because this is where no light reached the sensitized plate, the image formed is a direct reproduction of the original.

Powder-cloud development is similar, except that the fine particles of powder are air-borne, the cloud passing over the surface of the exposed plate. Special techniques are used to impart the correct polarity to the powder particles so that they will be attracted to the image areas of the plate.

To use the image developed by either of these methods, it must be transferred to a permanent support, such as a sheet of paper. The operation is simple; a sheet of paper is laid on the developed xerographic plate and an electrostatic field is formed by the same device used to charge the xerographic plate initially. This causes a large part of the powder, which forms the image on the plate, to move to the paper. The paper is then stripped off. The characteristics of suitable paper are not critical. More than a hundred different types of paper have been used successfully to accept the powder image. If desired, the image can be transferred from the paper to wood, metal, glass, plastics, or other solid materials. Flexible materials such as cloth can accept the image directly from the xerographic plate.

Because the image at this stage is held only loosely to the permanent support, it must be "fixed" to prevent smudging. Fixing generally is done by heating the image, because the powder is compounded with thermoplastic resin that fuses and therefore bonds firmly to the supporting surface. Other methods used successfully include partially dissolving the image by vapors of suitable solvent, using a pressure-sensitive surface to receive the image, or precoating the paper with a material that will hold the image permanently when heated.

Finally, because some powder is not transferred from the plate to the paper, the plate must be cleaned before it can be resensitized to receive another image. Usually, this is done by cascading a powdered material over the plate that scrubs the remaining powder from the surface. Rotating fur brushes also clean the plate excellently.

Commercial Equipment for Xerography

The first commercial equipment for xerography was placed on the market by Haloid in 1949. This equipment, trademarked "XeroX," consisted of the XeroX Copier, Model A. It could make single contact copies of letters, line drawings, office forms, and similar originals whose size did not exceed $8^1/_2$ in. × 13 in.

In 1951 Haloid supplemented this unit with the XeroX Camera No. 1, which permits copying material with text or images on both sides.

By 1952 the need had developed for a more flexible camera, leading to the provision by Haloid of the XeroX Camera No. 3. Essentially a small-scale process camera, this unit permits variable-size copying of originals as large as 17 in. × 22 in.

In 1953 the XeroX Lith-Master Camera No. 4 was produced. It is similar to the No. 3 Camera except for

Fig. 17 Haloid Lith-Master equipment for use in making offset master plates. Included are the fuser, processor, and camera. This equipment performs all of the steps shown in Fig. 16.

an improved lighting system, an easel attachment for copying record cards in panels, and relays for synchronizing the lights with the shutter and for controlling the fuser so as to balance the electrical load.

With the latest camera, Haloid also announced the availability of the XeroX Lith-Master Processor, Model X. Fig. 17 shows this Processor with a Fuser and Camera No. 1. This processor replaces the early Copier which previously had provided the only standardized equipment for sensitizing, developing, transferring, and cleaning. More convenient to use than the Copier, the Model X also provides a compartment for storing paper, with a pull-bottom to eject one sheet at a time. A plate dispenser at the top holds six XeroX plates, feeding them one at a time to the operator in sequence, insuring proper rotation of the plates for maximum plate life. A further advantage of the Model X Processor is that the developing system has been modified to develop solid areas and half-tones.

Uses of Xerography

Originally conceived as a means of making single copies of letters and other information for record purposes, xerography now is being used mainly to produce paper offset lithographic master plates. The process is identical with that for making single copies, except that the image on the xerographic plate is transferred to a specially prepared offset master plate rather than to a plain piece of paper. These offset plates are capable of producing large numbers of copies quickly and cheaply on small lithographic presses. Other methods of making lithographic offset plates for office duplicators, which involve photographic copying, cost from $2 to $4 for each plate and require from an hour to a day to obtain. By xerography, the total cost in most installations is less than 40 cents for each plate, and the plate can be on the press turning out duplicates within three minutes of receiving the original copy. In addition, the master plate prepared by xerography is more durable than paper plates prepared by other methods; more than 10,000 prints can be prepared from the average xerographic master.

Many different applications have been found for xerographically made offset plates. These include production-order writing, instruction manuals, technical reports, office and factory forms of all kinds, long-distance telephone routing slips, Pullman diagrams, salesmen's lists, and hundreds of others.

Xerography also has been used to produce enlargements of microfilm. In its simplest form, an adapter fitted to a microfilm reader permits exposing a conventional XeroX plate in a few seconds, and processing in the usual way in a XeroX Processor. If desired, a negative-to-positive developer can be used, giving black-on-white prints. Automatic equipment for enlarging from microfilm on a big scale has been produced by Haloid on an experimental basis, but it is not on the market as yet.

Fluid-Mechanics Equipment

EQUIPMENT which will expand college mechanical and aeronautical engineering laboratory facilities in the field of fluid mechanics has been announced by the General Electric Company's Apparatus Educational Sales Section.

The packaged device is an adjustable-blade, multistage, axial-flow fan with a cradled d-c dynamometer. It is designed to help give a better understanding of the fundamentals of energy transfer and fluid flow encountered in axial-flow turbomachinery.

Experiments performed with the unit can be equally applicable to the basic fluid mechanics of the multistage axial-flow compressor used in gas turbines and other applications. It also may be used in dynamometer absorption demonstrations as a prime mover driving other test machines, and as a low-pressure air supply of substantial volume for many types of laboratory test work.

The basic G-E unit consists of an axial-flow fan direct-connected to and mounted on a common bedplate with a $7^1/_2$-hp d-c cradled dynamometer. Dynamometer scale readings and speed provide for direct measurement of horsepower required by the fan for all test conditions.

The fan has a maximum speed rating of 3000 rpm, and the dynamometer, equipped with a field rheostat, 4000 rpm. However, as shipped from the factory, the field rheostat has a stop limiting the speed to approximately 3000 rpm. Minimum speed of the dynamometer is limited to approximately 500 rpm because of inadequate ventilation and cooling at lower speeds.

Variable voltage control for the dynamometer is provided by including a G-E speed variator utilizing 220-volt, 60-cycle, 3-phase current. This power supply unit provides continuously adjustable armature and field control permitting selection of any desired speed setting within the horsepower and speed rating of the dynamometer.

The fan assembly is made up of two stages with 24 identical rotor blades and 37 identical stator blades in each stage. All blades can be rotated 360 deg and a protractor-type template is furnished for accuracy in adjusting blade angles.

Rotor blades are individually cast of aluminum alloy. Stator blades are made of sheet steel formed to the proper shape.

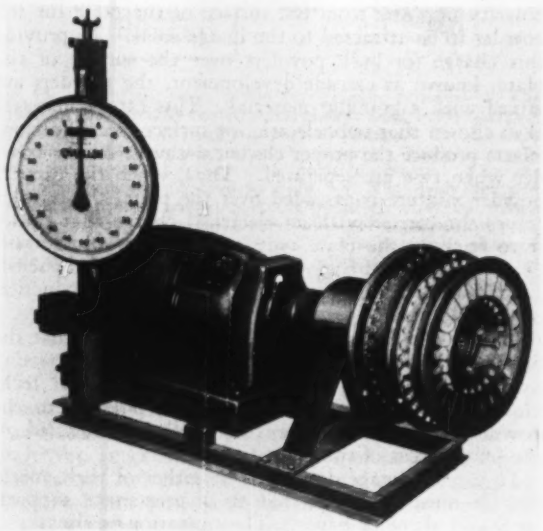
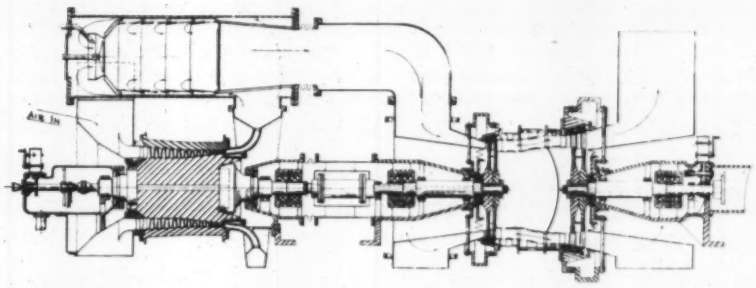


Fig. 18 Adjustable blade multistage axial-flow fan with d-c dynamometer

Substance in Brief of Papers Presented at ASME Meetings



Mobile gas-turbine power plant: 4500 kw gas-turbine unit; longitudinal section

Gas-Turbine Power

A 4500-KW Mobile Gas-Turbine Power Unit, by M. A. Mayers, Burns and Roe, Inc., New York, N. Y., L. F. Deming, Mem. ASME, Bureau of Yards and Docks, U. S. Navy, Washington, D. C., F. O. Hennig, Mem. ASME, and J. K. Hubbard, Clark Brothers Company, Olean, N. Y. 1953 ASME Annual Meeting paper No. **53—A-225** (mimeographed).

To PROVIDE for emergency power supply for Navy shore installations, the Bureau of Yards and Docks established requirements for a railroad-car-mounted mobile gas-turbine power plant in 1951. This paper describes the unit now being built by Clark Brothers Co., Inc., to meet these requirements. It will have a capacity of 4500 kw and will be mounted in a standard railroad car capable of travel in freight or passenger service on main lines of U. S. railroads. Provisions for control of shock loadings in transit are described. The unit is a complete power plant, requiring connections only to a source of fuel and the electrical load, and can be placed in service within 24 hours after arrival at the site. Careful attention has been given to control of accelerations during transit. The selection of standard commercial equipment assures reliable operation and a minimum of developmental difficulties. It is, therefore, anticipated that this plant will meet the needs of the service for mobile power equipment of large capacity better than was possible prior to the development of the heavy duty gas-turbine generator.

Mobile power units of this design may also be useful, as emergency power supplies, to public utilities and industrial companies. Wherever load centers are widely separated and transmission lines are subject to interruption, as in tornado or ice-storm areas, such mobile plants may provide the most economical and reliable means of limiting interruptions to service. They may also be found useful to maintain voltage at the ends of long transmission lines supplying seasonal loads.

Compressor Surge and Stall Propagation, by H. W. Emmons, Mem. ASME, C. E. Pearson, and H. P. Grant, Harvard University, Cambridge, Mass. 1953 Annual Meeting paper No. **53—A-65** (in type; to be published in Trans. ASME).

COMPRESSOR surge is shown by the application of several types of instrumentation (notably a hot-wire anemometer) to consist of two distinct types of phenomena. The whole compressor-flow system may be unstable in the manner of a self-excited Helmholtz resonator. The theory of this instability is presented and is shown to explain some of the observed pulsation symptoms. The stalling of the flow through the blade rows, which usually is assumed to be the origin of pulsation, is shown to occur in propagating groups of 1 to 5 regions involving from 2 to 20 blades each. The theory of this "stall propagation" shows the propagation velocity relative to the wheel to be dependent upon boundary-layer growth parameters and hence the frequency (relative to a stationary probe) to be proportional to the wheel speed. Another part of observed compressor pulsation thus is explained. These two phenomena frequently interact to produce complex performance characteristics.

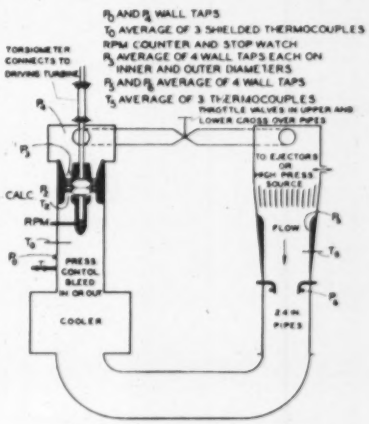
The theories presented are essentially correct as shown by experimental verification, but much remains to be done to make quantitative compressor-performance prediction practical.

Basic Compressor Characteristics from Tests of a Two-Stage Axial-Flow Machine, by W. R. New, Mem. ASME, A. H. Redding, Mem. ASME, H. B. Saldin, Mem. ASME, and K. O. Fentress, Westinghouse Electric Corporation, Philadelphia, Pa. 1953 ASME Annual Meeting paper No. **53—A-205** (mimeographed; to be published in Trans. ASME).

THE attainable pressure ratio per stage and efficiency of axial-flow compressors, working at subsonic gas velocities, may be expected to depend at least upon Mach and Reynolds Numbers in addition to all features of blading geometry.

The results of a high-speed test program on a two-stage axial-flow compressor, with one easily defined and accurately reproducible choice of blading geometry, are reported in this paper. The tests covered a range of Mach Numbers 0.3 to 0.9 and a range of Reynolds Numbers 50,000 to 500,000.

The relationships among the variables covered by this program are believed generally to be representative of the behavior of axial-flow compressor stages at subsonic velocities even though absolute values of loading and efficiency


P1 AND P2 WALL TAPS
T0 AVERAGE OF 3 SHIELDED THERMOCOUPLES
RPM COUNTER AND STOP WATCH
P1 AVERAGE OF 4 WALL TAPS EACH ON INNER AND OUTER DIAMETERS
P3 AND P4 AVERAGE OF 4 WALL TAPS
T2 AVERAGE OF 3 THERMOCOUPLES
THROTTLE VALVES IN UPPER AND LOWER CROSS OVER PIPES
TORSIOMETER CONNECTS TO DRIVING TURBINE
TO EJECTORS OR HIGH PRESS SOURCE
CALC.
RPM
FLOW
PRESS CONTOL BLEED IN OR OUT
COOLER
24 IN PIPES

Compressor test circuit diagram

are not indicative of the best current design standards. Three-dimensional diagrams showing the dependence of pressure ratio per stage and efficiency upon Mach and Reynolds Numbers are included to aid in visualizing these relationships. The results are then condensed into pairs of two-dimensional plots exemplary of types more convenient for extensive use.

Pin-Fin Heat-Exchanger Surfaces, by W. M. Kays, Assoc. Mem. ASME, Stanford University, Stanford, Calif. 1953 ASME Annual Meeting paper No. **53—A-211** (mimeographed; to be published in Trans. ASME).

THIS paper presents a summary of the available test data on compact pin-fin heat-exchanger surfaces, including both heat-transfer and flow-friction performance. Consideration has been restricted to in-line pin arrangements. It is shown that the circular pin-fin provides one method for obtaining very high heat-transfer conductances while at the same time maintaining high fin effectiveness. The more important conclusions are as follows:

1 Good performance from a pin-fin surface depends to a large extent upon the practicability of manufacturing a surface by production methods that will have a high ratio of pin-to-plate area, and at the same time effecting a pin-to-plate bond that is reasonably clean aerodynamically. The use of plate corrugations or channels transverse to the flow may result in prohibitively high friction factors without a compensating increase in plate conductance.

2 With in-line pin arrangement, a pin spacing closer than $3D$ in the transverse direction and $2D$ in the longitudinal direction may not be practicable because of the tendency of the flow to become completely laminar at the low Reynolds numbers where these surfaces will probably find their principal application.

3 In-line pin-fin surfaces show a tendency toward pin vibration, which is believed to be a Strouhal number effect. The critical Strouhal number appears to be in the range 2–5. This vibration results in an intense whistle as well as a noticeable increase in friction factor.

4 Heat-exchanger-design studies indicate that despite the high friction factors characteristic of pin-fin surfaces, it is possible to design heat exchangers with pin-fin surfaces that are competitive with comparable plain-fin or louvered-fin surfaces, but that the resulting heat exchangers will have characteristically a larger frontal area.

It is quite possible that the laminar flow and pin-vibration difficulties encountered with in-line pin arrangements could be eliminated or alleviated by the use of staggered arrangements, although this will probably also result in heat exchangers with still larger frontal areas because of the very high friction factors characteristic of staggered tube banks. In the long run, it may prove worth while to investigate the possibility of employing pins with a streamlined cross section in order to attempt to eliminate a large part of the form drag of the circular section. Employing wire drawn or stamped to a streamlined section may not be out of the question.

The Gas Turbine as a Prime Mover on U. S. Naval Ships, by W. M. M. Fowden, Jr., R. R. Peterson, Assoc. Mem. ASME, and J. W. Sawyer, Mem. ASME, Bureau of Ships, Navy Department, Washington, D. C. 1953 ASME Annual Meeting paper No. **53—A-233** (mimeographed).

THE Navy has made considerable progress on gas turbines for ships since 1938. Some of the engines and their application for auxiliary and propulsion drives are described in this paper.

The Navy has three gas-turbine engines which are developed and available for propulsive service. The first, the Boeing 502-2 (160 HP) is similar to other engines of the 502 series in that it consists of a single-stage centrifugal compressor of 3/1 nominal pressure ratio when rotating at 36,500 rpm; a two-stage axial-flow turbine, the first stage of which is coupled to and driving the compressor. The second turbine stage is physically disconnected from the first stage, and, except for air mass flow, is independent of the first stage. The other two propulsion engines, the Metropolitan-Vickers G-2 and the Rolls-Royce RM-60, have been purchased from the British, and plans are being drawn up for their installation in a Motor Torpedo Boat and a Destroyer Escort, respectively.

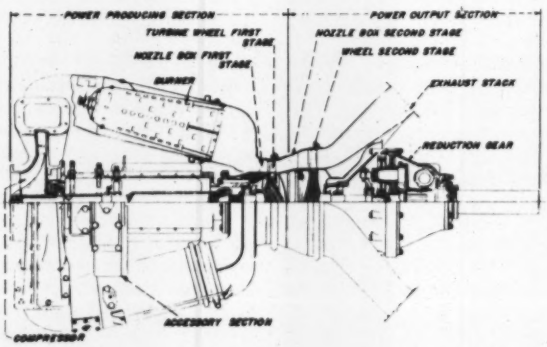
The gas turbine offers a number of outstanding features that make it well suited for driving auxiliary units. As a unit for intermittent operation, the gas turbine is generally a highly competitive prime mover even when matched against the gasoline or diesel engine. For intermittent operation, over short periods of time, such as would be encountered in emergency generator sets or certain pumps, the relatively high specific fuel consumption is of little concern. The advantages of lightweight, dependability, and easy starting may more than offset the feature of high fuel consumption.

With the continuing demands to make more efficient use of available space and to pack more power into a given volume, investigations are continuing to find new applications for the gas-turbine engine. Numerous uses such as drives for forced-draft blowers, emergency generators, pumps, ship-service generators, and others have been or are under consideration.

The auxiliary power applications that are being developed by the Bureau of Ships for the gas turbine include the following engines: Solar T-45, Boeing 502-6, Solar T-400 (completed), and Solar T-520.

In conclusion the paper states high initial cost, poor fuel economy (especially at part-load operation), and short life are the major hurdles which must be overcome before the gas-turbine engine can be applied generally in Naval Ships. Marine diesel engines can be purchased for approximately one quarter to one tenth the price of a comparable gas-turbine engine depending on the service desired. Fuel consumed by the gas-turbine engine is two to three times as much as a diesel engine depending on the size selected. "Short life" is defined as 500 hours at full power.

On the basis of developments in the gas-turbine field within the past ten



Boeing model 502 gas-turbine engine for U. S. Naval ship propulsion

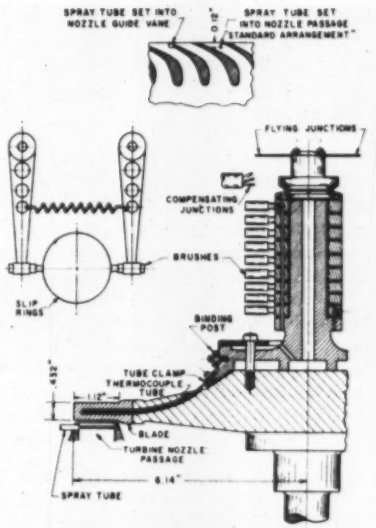
years and the demonstrated performance of present shipboard installations, we can anticipate continued exploitation of the gas turbine's small size during the next decade. These developments may be of sufficient magnitude to reduce the initial cost measurably. In our new ships we will see portable pumps, electric generators, and other emergency and stand-by equipment powered by gas turbines due to their small size, ease of starting, and reliability. In the propulsion field, gas turbines will make great strides when applied to small high-speed craft. These boats will be even faster with two to three times as much power in the same volume. Special applications will be found also for these small machines. Compact units from 50 to 10,000 shp will cover the range of simple-cycle machines aboard ship with growing emphasis on the larger powers.

A Novel Cooling Method for Gas Turbines, by Edward Burke, Assoc. Mem. ASME, and G. A. Kemeny, Westinghouse Research Laboratories, East Pittsburgh, Pa. 1953 ASME Annual Meeting paper No. 53—A-180 (mimeographed; to be published in Trans. ASME).

THE paper discusses the cooling of turbine blades by direct water spray. This method was first studied at the Westinghouse Research Laboratories in 1947. The research originally was done under contract with the U. S. Navy, Bureau of Ships, and was classified until 1952. Work along similar lines has been conducted by the British National Gas Turbine Establishment since 1950.

The desirability of high inlet temperatures for gas turbines, as a means of increasing both the efficiency and the output per pound of working fluid, is well known. Blade cooling has appeared to be an attractive means of operating turbines at gas temperatures which would otherwise be excessive for the blade materials.

Water (or possibly some other liquid coolant) is sprayed directly onto the rotor blades of a gas turbine from orifices in tubes located near the trailing edge of the turbine-nozzle guide vanes. The liquid impinges on the rotor blades forming a layer which serves both to insulate the blade from the hot-gas stream and to extract heat from the blade. Results of experiments on a supercharger, with gas temperatures between 1150 and 2350 F, and theoretical studies of the effect of spray cooling on cycle efficiency indicate that spray cooling, by permitting higher gas temperatures, should increase both output and efficiency of a gas-turbine power plant. Heat transfer in a spray-cooled blade is discussed.



Detail of thermocouple and spray-tube installation

The Free-Piston and Turbine Compound-Engine—A Cycle Analysis, by A. L. London, Mem. ASME, Stanford University, Stanford, Calif. 1953 Annual Meeting paper No. 53—A-212 (mimeographed; to be published in Trans. ASME).

A SIMPLIFIED cycle analysis is presented for a compound-engine of the free-piston type. To allow ready algebraic formulation, the assumption of perfect gas behavior with suitably averaged specific heat magnitudes is employed. The influence of compressor, turbine, and mechanical "inefficiencies" as well as the effects of valve pressure drops and coolant jacket heat transfer are included. The calculated parameters of specific flow rate, specific fuel consumption, and turbine-inlet temperature are consequently realistic performance estimates, as shown by comparison with available test information.

Results of the analysis clearly indicate the importance of component losses on turbine-inlet temperature and plant specific fuel consumption and point out the unique characteristics of the cycle. Consideration also is given to the "supercharged-intercooled" and the "reheat" variants of the simple free-piston compound engine. A study of methods of load governing leads to the important conclusion that in order to realize a flat part-load economy characteristic, comparable to that of a diesel, it will be necessary to obtain a turbine design which achieves high part-load fuel economy, but probably will require the use of a variable area nozzle turbine.

Fuels Technology

Underground Gasification of Coal at Gorgas, Alabama, by M. H. Fies, Alabama Power Company, Birmingham, Ala., and J. L. Elder, Bureau of Mines, Gorgas, Ala. 1953 ASME Annual Meeting paper No. 53—A-137 (mimeographed).

THE Federal Bureau of Mines and the Alabama Power Company have cooperated, since 1946, in a series of field-scale experiments on the underground gasification of coal. The primary objectives are to recover at low cost either the chemical constituents or the energy of coal in forms suitable for the synthesis of liquid fuels and organic chemicals or for the production of power. During the course of experiments up to the present time various methods of gasification have been tried: Stream-type operation, utilizing passages in the coal bed prepared by conventional mining methods; an electrical method of establishing an underground gasification passage for mining procedures employed previously; unidirectional flow and other changes in site-preparation procedure; oxygen gasification; and cyclic operation, using an air flow followed by a steam run. Experience with these various procedures and other operating details are discussed in the paper.

The underground gasification of coal using electrolinking carbonization as a method of site development followed by gasification with air, oxygen, or cyclic operation using alternate air and steam runs, at this stage of development is, according to the paper, technically feasible for application in producing either a power or synthesis-type gas.

In gasification with air, a lean producer gas is made which can be used at the point where produced in generating electric power, possibly by means of gas-turbine installations. Other usage may be found in industries requiring large quantities of heat which can be located at the source of energy production.

Substitution of oxygen for air results in the production of a nitrogen-free and improved-quality gas. The results of only one gasification test with oxygen are available and these indicate the need for additional experimental work directed toward the control of the operation and reduction in the oxygen consumption. A gas suitable for synthesis can be produced by this method. A definite advantage of gasification with oxygen is the complete gasification of coal in the bed and the leaving of minimum coke residues.

The alternate gasification with air followed by steam runs provides an improved-quality product at a minimum

cost. The experimental work on cyclic operation is of a qualitative nature, and further work is necessary to specify the optimum air-blow and steam-run cycles. It is possible to produce either a power or synthesis gas by this method. In gasification with steam as compared with gasification with air, experimental results indicate that an improved carbon utilization can be achieved and the quantity of coke residue underground decreased.

According to the paper, at this early stage in the development of processes of underground gasification of coal, it is encouraging to state that an economically feasible process will result. Additional experimentation is required to further develop the necessary technology.

Significance of Liquid-Fuel Tests, ASME, PTC No. 3 Report, by W. Nacovsky, Consolidated Edison Company, New York, N. Y. 1953 ASME Annual Meeting paper No. **53—A-130** (mimeographed).

ASME, PTC No. 3, Fuels Committee has had for consideration the revision of the Society's test code on liquid fuels. As a preliminary step, two members of this Committee collaborated in the preparation of comments relative to the significance of tests used in the evaluation of fuel oils. These comments were received favorably by the Committee and were considered worthy of presentation to the Society as a springboard for further development.

This Committee has studied laboratory methods of test of the physical or chemical properties of fuel oil which may be desired for fuel-oil specifications. In each case, the significance of the test procedure is stated in order that an intelligent approach may be made in the formulation of any type of specification. Strictly speaking, the word "specification" may be misconstrued by the user or buyer to mean one thing when it may mean something entirely different to the seller or refiner. In general, there are three types of fuel-oil specifications as follows: (1) General sales classifications. (2) Manufacturing specifications. (3) Specifications for particular industrial applications.

The test procedures discussed are reviewed bearing in mind some of the broad aspects of fuel-oil testing as related to continuous-flame fuel-oil burners. Strict adherence to absolute analytical procedures is a requisite for design and construction of many units of equipment. Similarly, accurate test data is desirable for acceptance and performance tests on these units of equipment. However, in the normal course of practical, applied engineering, it is generally more important to estimate trends of performance by proximate methods which are rapid, easy to do, and made on apparatus in common usage.

It is recognized that the details of many of the test procedures in this code have no direct significance for many users of liquid fuels. The small consumer may make no tests at all, yet he is entitled to the protection and service provided by proper testing on the part of his vendor and by the manufacturer or refiner. An attempt has been made to group the various methods of test in the light of probable usefulness by organizations having diverse needs.

Boiler and Furnace Designed for Spreader-Stoker Firing, by L. H. Coykendall, Mem. ASME, and P. R. Loughin, Mem. ASME, Babcock & Wilcox Company, New York, N. Y. 1953 ASME Annual Meeting paper No. **53—A-136** (mimeographed; to be published in Trans. ASME).

THIS paper includes a brief review of the history of spreader-stoker firing and describes the development of a standardized furnace and boiler design particularly adapted to the spreader stoker. Test results present coal analysis, ash balance, and flue-dust loading, distribution, combustible content, and size consist, as well as gas temperatures and draft differentials throughout the unit.

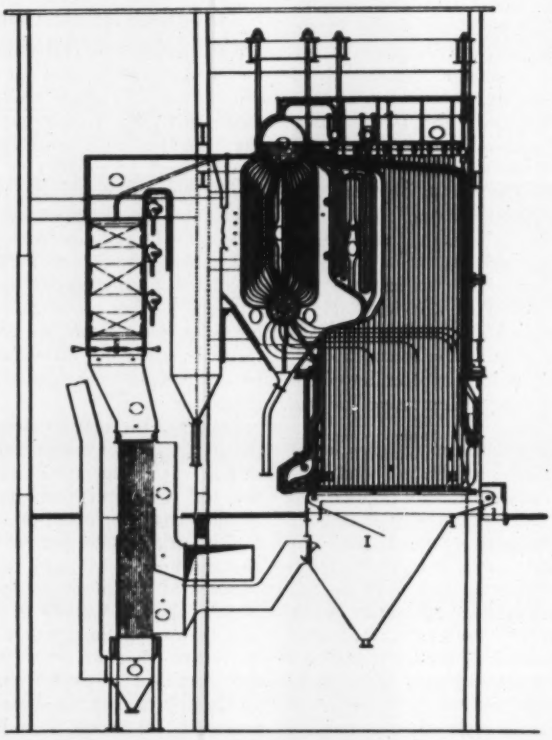
Operation and field service reports on a number of these standardized units have confirmed that the design specifications are sound and that they have been attained or exceeded. These include the following:

1 The use of tube-to-tube construction in the rear wall and arch is very desirable, as indicated by its ability to shed dry-ash deposits as they accumulate.

2 No troublesome slagging or brickwork maintenance on the tube-and-tile side and front walls has been reported, indicating that the objective of maintaining a high temperature in the lower part of the furnace to promote more complete combustion has not resulted in trouble from these sources.

3 The ability of the furnace arch to promote turbulence and good furnace absorption is confirmed by the relatively low average temperature of the furnace exit gas.

4 The horizontal slag-chill tubes at each side of the grate have functioned as intended. There has been no failure



Installation on which a complete series of tests was obtained, including dust-loading data. This unit is fired by a Detroit Rotograte spreader stoker and was designed for a capacity of 160,000 lb per hr continuous and 177,000 lb per hr; 4 hr peak.

or other signs of distress in them, indicating that circulation, as designed, is entirely adequate.

5 Some of these units have been in service for over two years at high load and no pressure-part erosion can be detected in the superheater and boiler banks.

6 The collection efficiency of the boiler cinder hoppers ranges from 27 per cent to 35 per cent, depending upon the raw-coal sizing. Observation has confirmed that there is no gas by-passing of the boiler bank through these double hoppers.

7 Predicted steam temperature has been obtained on a majority of these installations which justifies the design provisions incorporated for this purpose.

8 The absorption in the boiler bank has been found to be somewhat better than expected and our design factors accordingly have been changed to take advantage of this increase in efficiency.

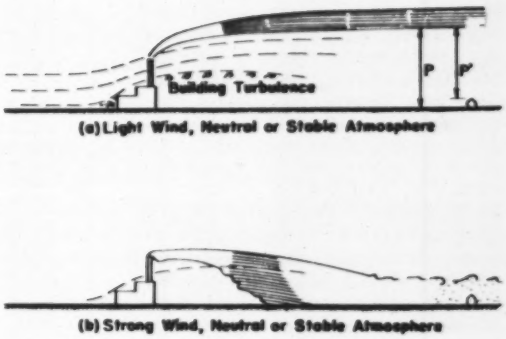
Interface-Extension Versus Upper Limiting Time-Mean Energy Release Rates of the Constant-Pressure Steady-State Combustion Process, by W. J. Wohlenberg, Fellow ASME, Yale University, New Haven, Conn. 1953 ASME Annual Meeting paper No. **53—A-103** (mimeographed; to be published in Trans. ASME).

THE concepts of size and distribution of the mass elements sheared out by turbulence are added to the interface theory. This enables inclusion of the parameter interface-extension in terms of the surface-volume ratio of such mass elements. The reciprocal of this ratio is the hydraulic mean depth of the mass elements which, in turn, is of the same order of magnitude as is the thickness of gaseous layer of the tail-end thermal diffusion process which is always present in the combustion process just prior to the major portion of the terminal chemical or molecular collision phases of the reaction.

In applying this theory, it is found that, for the higher levels of energy release rate, the mass elements must be so small, in order to provide the necessary interface-extension, that the possible magnitude of tail-end diffusion is so small as to preclude any possibility that it could exercise a major influence in control over the reaction rate. This now resides in the terminal chemical phases of the reaction.

The quantitative aspects of the preceding remarks are based on results of an application of the theory to dodecane, the theory being generally applicable to second-order reactions, but the accuracy of such results appears for the present as limited to their orders of magnitude. A large part of this uncertainty stems from uncertainty in available values of the energy of activation. Except for this, the disclosed quantitative aspects should not be far from the real facts for the cases considered, provided the deduced mass element sizes are actually realized.

However, the theory does not include the formulation necessary to an evaluation of the physical and turbulent histories required to bring these conditions about. Thus the reader, along with the author, is left sitting, as it were, on a perch in space, which, at the least, serves as a new and advantageous position from which to view the combustion process and, at most, indicates the upper limiting possibilities of the combustion process. But, as yet, means required to establish the perch itself are not known in detail. When this gap has been filled, the interface theory may be considered as reasonably well along toward adequacy.



Basic patterns of gas flow

Design of Chimneys to Control Downwash of Gases, by R. H. Sherlock and E. J. Lesher, University of Michigan, Ann Arbor, Mich. 1953 ASME Annual Meeting paper No. **53—A-80** (mimeographed; to be published in Trans. ASME).

THIS report describes the results of an investigation which is intended to reduce the problem of controlling the downwash of stack gases to a design basis, so that in the future it will be necessary to conduct additional research projects only in those cases where unusual conditions prevail. Only aerodynamic influences are considered as a cause of downwash, since it is one of the adverse influences which definitely can be brought under control and since practically all of the cases of persistent downwash in the immediate neighborhood of most plants are from this cause. However, the other influences are discussed so as to establish their relation to the general problem.

A steam-electric power plant is used as a working example. The experiments described in this report were of such scope as to enable the engineer to predict the pattern of stack-gas behavior at power plants having a size up to about a half-million kilowatt capacity and where the terrain is not so extraordinary as to constitute a special case.

Diagrams are given which show the dimensions of the hypothetical stations used in the test, together with diagrams of some of the supporting data, and a summary sheet which shows the relation between the wind velocity, the stack-gas velocity, the height of stack, the height of the gas plume, and the height of the building.

Only a short description of the testing procedures and equipment is given since a more complete report of this work will appear in Engineering Research Bulletin, No. 38, University of Michigan. The Bulletin also will contain additional cases for (1) a variable plant load and (2) for a situation where the gases must pass over a moderately high hill.

An illustrative example is given in this paper in the form of a case which may arise in plant design. It assumes a plant situated in flat country and operating under full load for the entire year.

Economics of Ash Handling, by L. E. Mylting, Mem. ASME, Allen-Sherman-Hoff Company, Wynnewood, Pa. 1953 ASME Annual Meeting paper No. **53—A-48** (mimeographed).

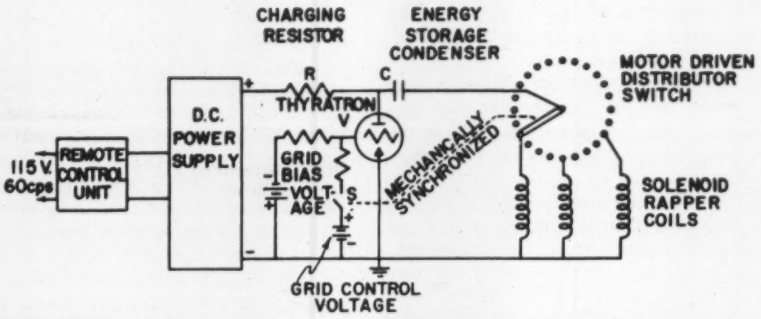
CAPITAL investment and operating costs must be considered completely in order to develop an optimum ash-handling design. Partial analyses are misleading. The capital investment includes not only the erected ready-to-operate costs of the actual ash-handling equipment, but also the costs of equipment required for furnishing electric power, water, and compressed air. Pump and compressor facilities may be taken as one item exclusive of power requirements for these facilities.

These power requirements, added to all other power requirements, produce a total which must be provided for with switchgear, copper, generating capacity, clear back through the coal-handling equipment. A rational evaluation of power would be to apply the unit-plant cost per kva installed against the number of kva demand of the ash-handling system. This method places a premium on power requirements, which is entirely rational. A generally and uniformly applied method of evaluation of ash-handling systems along these lines would provide an important guide for design of economical first-cost ash-handling systems.

A complete evaluation of operating costs should include operating labor and power, and total maintenance. Maintenance should not only include materials and labor, but also the cost of outage time directly chargeable to the ash-handling system. The modern unit system makes outage time of any component of the unit a very costly item. Although the total cost of ash-handling equipment in large plants is less than 1 per cent of the total plant cost; less than 4 days outage per year due to maintenance on the ash-handling system represents a 1 per cent reduction in effective plant capacity. The cost of a short outage may well represent the entire cost of the ash-handling system. These considerations point to a need for a careful study of initial and operating costs including costs of potential outages.

A Magnetic-Impulse Rapper System for Electrical Precipitators, by H. J. Hall and T. A. Pierson, Assoc. Mem. ASME, Research Corporation, Bound Brook, N. J. 1953 ASME Annual Meeting paper No. 53—A-131 (mimeographed; to be published in Trans. ASME).

CONSIDERABLE effort is being made to reduce atmospheric pollution from industrial fumes and dusts. Attendant with this effort is the problem of transferring waste products, trapped on electrodes of electrical precipitators, to hoppers. Loss or disturbance of waste material or interference with the collecting unit must be minimized. Traditional methods of "rapping" the electrodes to dislodge the collected material leaves much to be desired. Therefore, a new method utilizing the magnetic-impulse rapper was developed to provide the continuous rapping needed to convert precipitation from a variable batch process to a continuous and uniform process. This paper discusses the historical background, operating characteristics, design considerations, and application of the electromagnetic-rapper system.



Basic electrical circuit diagram for magnetic-impulse rapper system

The magnetic-impulse rapper system was first applied to the collecting-plate cleaning operation on flyash precipitators in the summer of 1949. At the present time, magnetic-impulse plate rappers are being specified on all new Research Corporation flyash precipitators. The method also has been used successfully on a number of other precipitator applications, including gypsum, cupola furnace dust, open-hearth gas cleaning, iron-ore sintering plants, and others.

Within the past two years the continuous rapping method and the magnetic-impulse rapper system also have been applied to high-tension electrode cleaning. For this purpose, the standard plate-rapper solenoid unit is mounted vertically on a porcelain-post insulator through which the rapping energy is transmitted via a metal rod directly to the high-tension electrode frame supporting the discharge wires or rods inside the precipitator.

Wood Industries

Forest-Fire Insurance in the United States, by H. B. Shepard, Federal Reserve Bank of Boston, Boston, Mass. 1953 ASME Annual Meeting paper No. 53—A-200 (mimeographed).

FIRE-INSURANCE practice is favored by good fire protection. The relationship is fundamental. From small beginnings nearly 50 years ago, organized forest-fire protection has made great progress in the United States. According to U. S. Forest Service records 61 million acres of forest land owned privately or by the individual states were under protection in 1912. By 1937, the protected area had grown to 256 million acres and, in 1952, organized protection had been extended to nearly 369 million acres, 84 per cent of the 439 million acres in this general class of ownership, exclusive of Alaska. By 1950, in 30 states, chiefly in the North and West, 100 per cent of the forest land was under protection. In 15 states, mainly in the South, areas protected ran between none and 96 per cent. Data were incomplete in three states.

The expenditure for fire protection on private and state lands in 1911 was $250,000. In 1950, the amount available for this purpose was more than $30 million. Even allowing for the much greater present-day costs, this is a substantial increase. The 1950 amount was equal to more than eight cents per acre protected.

The underwriting of forest-fire insurance will not be simple according to the paper. Neither is the underwriting the fire-insurance carriers are doing now. But they know from experience that careful attention to detail pays off in the end. The ultimate success of forest-fire insurance will be better assured when well-founded decisions are made with respect to the design of differential rating schedules based on accurate identification and measurements of hazards. Premium rates must allow for possible inaccuracies in the calculations; for adverse selection of risks—the insured portion may not be a perfect sample of the whole; for accumulation of reserves against conflagration and other contingent hazards; and other unknown factors.

The policy forms must include the essential protective clauses—protecting both the insurer and the insured. Co-insurance requirements must be agreed upon. Full indemnity may not be advisable at the start and decision on amounts deductible would be essential. Provision should be made for types of policies attractive to large owners who are self-insurers against ordinary fires.

A standard system for grading protection organizations would be indispensable following the general pattern by which cities and towns are now graded according to the effectiveness of their fire and police departments, their water

supplies, hydrant systems, and other protective facilities. These are some of the more obvious aspects of work that would need to be done preliminary to the writing of forest-fire insurance. There are others among which is effective business promotion.

In final substance it appears that the insurance of forest properties against fire damage should be patterned after the practices applied to the insurance of buildings and stocks of goods. Accurate indemnification of the insured's real financial loss, in compliance with the terms of the policy, should be the objective. There do not appear to be any insurmountable obstacles in the way toward this objective.

Forest-fire insurance offers an opportunity for expansion of the established fire-insurance organizations, stock and mutual, in the United States. If they decline to embrace this opportunity for what they believe to be good and sufficient reasons forest owners should give serious consideration to the organization of forest-fire-insurance carriers among themselves. In whatever way it is supplied, fire insurance has the capacity of conferring benefits on forest owners, as a class, of value at least equal to what they should be asked to pay for it.

The advent of forest-fire insurance is overdue. Properly conceived and managed, it has the capacity to become a successful business enterprise in its own right. An action program, directed toward large-scale development, would be an appropriate undertaking.

Building Accuracy Into Small Sawmills, by E. A. Clevenger, Corley Manufacturing Company, Chattanooga, Tenn. 1953 ASME Annual Meeting paper No. 53—A-202 (mimeographed).

IN BUILDING accuracy into a mill, the basic essentials apply, regardless of size. The smaller the mill, the more necessary it is that the manufacturer take every precaution to assure accurate cutting. The smaller the mill, the more likelihood that it will be handled by a less experienced operator. Much of the timber that is butchered, miscut, and wasted is the result of teaming up a poor piece of equipment with an inefficient operator. Therefore, the sawmill builder must design his mill and manufacture it so that it will cut accurate lumber even when used by an inefficient lumber producer.

This paper shows what can be done at the factory to assure accurate cutting from a circular sawmill.

It is a combination of many small details that adds up to built-in accuracy. A circular sawmill is made up of three major components. First, the husk, or saw cab, which supports the saw mandrel and houses the feedworks. Second, the carriage, whose sole function is to carry the log through the saw. The log when on the carriage rests on metal supports called headblocks. These headblocks have L-shaped knees which push the log forward by means of a setworks, an apparatus for gaging the width of the board to be cut. Third, the trackway, on whose rails the carriage rolls back and forth.

Since these three major components form an inseparable team, it is essential that they be designed to work together. They must be planned so that their installation at the site can be accomplished in a minimum time and with a minimum amount of measuring by the operator. Some manufacturers simplify the procedure by furnishing notched mud sills on which the husk and trackway can be fitted. A more satisfactory method is to provide metal legs or brackets for the husk. These can be so designed that they will bolt also onto the center section of track in such a manner that there is automatic alignment. Thus, the operator can be sure that his carriage headlocks will be in proper relation to his saw collar in both height and distance. This is a typical example of how the sawmill manufacturer can use a seemingly minor improvement to help the operator cut accurate lumber.

To insure accuracy in the small sawmill the designer must plan with two objectives in mind. First, to build a mill that will be in alignment from the start. Second, to provide adjustments that will make alignment possible after wear has robbed the mill of its initial accuracy.

A vital point to built-in accuracy is the use of jigs and fixtures. Jigs and fixtures should be used throughout the manufacturing process. When this is done it is possible to assemble a complete mill from parts which have been processed at different previous times. Manufacturing costs can be held down since parts can be run in the most economical quantities and used as needed. Such a practice has an even further advantage to the ultimate user, since he can know that any replacement part will fit exactly the same as the original part.

In designing the small mill, it is highly important that numerous adjustments be provided if accuracy is to be maintained in the finished product. These adjustments must be incorporated at every point where wear is likely to affect alignment. It is also imperative to design the adjustment features so that they are simple in operation and easily made in the field by the inexperienced operator. They should also be made so that adjustments can be completed with the use of the more simple hand tools usually found in such an operation.

Design of Saw Blades for Better Dimensional Control, by D. E. Gommel, Atkins Saw Divisions, Borg Warner Company, Indianapolis, Ind. 1953 ASME Annual Meeting paper No. 53—A-201 (mimeographed).

IN SAWMILL operation, the saw blade and the kerf it cuts are two of the controlling factors to the efficiency of the operation, to the quality of the product, and to the financial return realized. The design of the saw blade predetermines what can be expected of the saw blade in obtaining better dimensional control of the lumber to be cut. Various factors involved in this design are discussed in this paper.

The factors in the design of the saw blade that result in better dimensional control of the lumber being cut are considered in the sequence of operations in the manufacture of the saw blade itself: The saw blades used in the sawmill, the material of the saw-blade plate, the tooth forming, the heat-treatment of the saw-blade plate, smithing and hammering of the saw blade, grinding of the saw-blade plate to gage, the tooth fitting, and inspection.

Other factors considered as to the design and operating details of the saw blades are the saw machine, the manufacturer of the saw blade, the speed and feed ratio, the clearance of the saw blade in the saw kerf, the gage of the saw-blade plate, types and hardnesses of the cutting teeth, what saw blade is needed for the job maintenance of the saw blade.

The paper mentions the following new developments in the saw-blade design:

The stabilizing holes are being used in the smaller saw blades with great success. They are replacing the expansion slots and are doing a better job.

Inserted-tooth holders are now on the market with a chip-breaker shelf projecting out from the gullet-face surface. This novelty breaks up the saw shavings into definite size chips and deposits all of them in the sawdust pit.

The new hard-metal tooth points such as inserted teeth with cutting edges of high-speed steel, stellite, and tungsten carbide are another new development.

Saw blades with tungsten-carbide tips brazed in position are doing a good job in the smaller saw sizes.

There is also a carbide-tipped saw blade with one planer tooth in the body of the saw blade. This planer tooth is a few thousandths of an inch wider than the other carbide tips and allows it to shave the side of the saw kerf to a smooth finish ready for gluing.

Spark-Arrester Performance Studies, by H. Buchberg, Assoc. Mem. ASME, University of California, Los Angeles, Calif. 1953 ASME Annual Meeting paper No. **53—A-198** (mimeographed).

MANY field and forest fires have been attributed to ignition by hot carbon particles in the exhaust stream of internal-combustion engines of motorized equipment. Spark arresters which capture and retain the carbon particles entrained by exhaust gases have been developed and are used as a fire-preventative measure.

The existing SAE specification for testing the performance of spark arresters for internal-combustion engines requires a laboratory having several representative sizes and types of internal-combustion engines equipped with dynamometers. The possibility of conducting tests in the field is remote in view of the test requirements, particularly the necessity for a dynamometer and other instrumentation. The existing specification is regarded as impractical for most Forest Service conditions. For these reasons it was desirable to develop simplified apparatus and a test procedure.

An investigation was undertaken to establish the validity of a simplified performance test of spark arresters used on the exhaust stack of internal-combustion engines for the purpose of capturing the entrained carbon particles. The standard SAE test for spark-arrester performance served as a criterion. Tests on several commercial spark arresters were performed in accordance with a simplified test procedure utilizing a blower, metering section, and unheated air.

From an over-all performance point of view, the simplified test proved to be a satisfactory method of screening spark arresters. However, it was found that an accurate evaluation of the performance of spark arresters which are highly sensitive to inlet-velocity pulsations can only be made by direct engine tests or by simulating the pulsations in flow with the simplified apparatus. The latter scheme must receive experimental verification.

Better Yield Through Dimensional Control in Small Sawmill Operation, by J. S. Bethel, North Carolina State College, Raleigh, N. C. 1953 ASME Annual Meeting paper No. **53—A-199** (mimeographed; to be published in Trans. ASME).

SMALL sawmills are often criticized on the lack of dimensional control in their products. The opportunities presented for increasing yields by control are discussed in this paper along with the realization of increased profit to the operator.

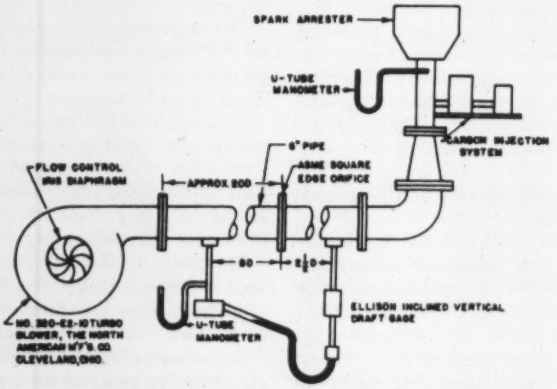
If a sawmill operator is to gain the maximum yield through improving control of dimension the following two steps are required:

1 Bring the lumber manufacturing process into a state of statistical control.

2 Improve the basic accuracy or capability of the sawmill.

Bringing the process into control means creating a condition in which the variation among boards represents a stable system of chance causes. The most frequent causes of lack of control have been found to be poor mill setup, inadequate power, improper saw lead, poor saw maintenance, improper carriage alignment, careless setting, improper calculation of cut, and inadequate dogging. Correction of these defects usually can be accomplished by a tightening up of the operating organization. Close and intelligent supervision of the enterprise during mill setup and operation can result in correction of most of the assignable causes for lack of control.

Improving the basic accuracy or capability of the sawmill usually involves a more fundamental change in the equipment. It may mean the replacement of the sawmill with a new one. At the least it is likely to mean replacement of worn, damaged, or misfit parts.



Schematic diagram of simplified test apparatus for spark-arrester performance tests

Fluid Meters

Small Nozzles and Low Values of Diameter Ratio, by H. S. Bean, Fellow ASME, National Bureau of Standards, Washington, D.C., R. M. Johnson, Mem. ASME, Ingersoll-Rand Company, Phillipsburg, N. J., and T. S. Blakeslee, Assoc. Mem. ASME, Lafayette College, Easton, Pa. 1953 ASME Annual Meeting paper No. **53—A-155** (mimeographed; to be published in Trans. ASME).

IN 1943, the National Bureau of Standards calibrated ten sets of nozzles for the Heat Exchange Institute, using adapters originally intended for open inlet or discharge conditions, in a modified arrangement for in-line measurements. These calibrations were made with air. Since then, new adapters have been prepared to facilitate using them in the "in-line" manner. Two sets of the nozzles have been recalibrated using these new adapters and a weighed-water procedure. The results of these new calibrations are presented and a comparison made with the earlier results. For most of the nozzles, the agreement between the original air calibrations and the recent water calibrations is well within the range of experimental uncertainties.

Coefficients of Float-Type Variable-Area Flowmeters, by V. P. Head, Assoc. Mem. ASME, Fisher & Porter Company, Hatboro, Pa. 1953 ASME Annual Meeting paper No. **53—A-208** (mimeographed; to be published in Trans. ASME).

A UNIFORM method of correlating flow data for all float-type variable-area meters is presented. Curves correlating the results of 73 calibrations of rotameters in $^1/_2$-in. to 2-in. sizes and suitable for general flow-calculation purposes are presented. Installation influences are discussed. A theoretical equation combining energy and momentum considerations is presented and compared with available data for incompressible flow.

It is pointed out that the float-type variable-area flowmeter fills a definite

need in the measurement of flow in 2-in. pipes and smaller and at low Reynolds numbers in larger pipe sizes as well. Its cost may be prohibitive in pipe sizes above 4 in. unless accurate measurement over a high-range ratio is required or unless normal piping layouts fail to provide the long runs of installation piping required for otherwise less costly primary elements such as concentric orifices.

An adequate theory for estimating performance of a wide variety of float shapes has been made available, and correlations which show promise of eliminating the need for costly calibrations in test work are available. These correlations are already in use in the general application of industrial instruments, but further test work with controlled float-edge sharpness and careful mechanical inspection, preferably by independent laboratories, is required before a tolerance for the uncalibrated test-type instrument can be stated with confidence. Whether this tolerance and the inspection costs necessary to achieve it can compare favorably with the tolerance and cost of individual calibration of test-type instruments remains to be seen.

Pulsation Absorbers for Reciprocating Pumps, by E. G. Chilton, Assoc. Mem. ASME, and L. R. Handley, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif. 1953 ASME Annual Meeting paper No. **53—A-81** (mimeographed; to be published in Trans. ASME).

PULSATION absorbers (or surge bottles) are often required in reciprocating-pump installations where pipe vibration, flowmeter errors, and other disadvantages of pulsating flow must be eliminated. Graphs are presented, based on theoretical analyses, for sizing such absorbers for any given installation and desired pulsation amplitude. Experiments with a laboratory unit as well as a few full-scale plant installations confirm the theoretical results. Recommendations are also made for certain important design details.

Pulsating-Flow Measurement—A Literature Survey, by A. K. Oppenheim, Mem. ASME, University of California, Berkeley, Calif., and E. G. Chilton, Assoc. Mem. ASME, Shell Development Company, Emeryville, Calif. 1953 ASME Annual Meeting paper No. **53—A-157** (mimeographed; to be published in Trans. ASME).

TECHNICAL publications on the measurement of pulsating flow are reviewed. Fundamental aspects of the subject are stressed, and applications of pressure-differential meters are emphasized because of their importance to industry. Problems related to these meters are classified into those concerned with flow through the meter test section, the effect of the flow system on the meter, and the transmission of the signal from meter to recorder. Operation and application to pulsating flow of other meters such as the turbine type and electromagnetic flowmeter, the hot-wire anemometer, and the so-called "true mass-rate flowmeter" also are outlined. A summary of information available in codes and manuals is included.

Aviation—Air Cargo

Ground Handling of Air Cargo, by J. L. Hennessy, Lt. Com., Supply Corps, U. S. Navy, and Director, Air Traffic Division, Bureau of Supplies and Accounts, Department of the Navy, Washington, D. C. 1953 ASME Annual Meeting paper No. **53—A-239** (mimeographed).

IN THE Navy, cargo begins to look like a candidate for air shipment when the material is taken out of storage and is delivered to the packing floor. While this is going on, traffic personnel are considering the particular problem involved and, where appropriate, are giving the packer advice as to the transport media which they expect will be used. The packer then prepares the material for shipment, attempting to pack the shipment with minimum outside dimensions and with the lowest practical tare weight. When the material is packed and ready to move (with the exception of some of the final markings) information as to actual weights and dimensions is given to the local traffic office. The local shipping officer, under regulations, has been given limited authority to effect shipments destined to continental consignees. Where larger shipments are involved, or where international airlift is required, a request for routing must be transmitted to a central traffic management agency for action. The rules and guidance relating to all cargo movements are contained in the Navy Shipping Guide which is issued by the Bureau of Supplies and Accounts to all Navy shipping activities throughout the world.

The central traffic management agency now becomes involved in the shipment. After consideration of the cargo involved, and the transport situation existing at the time, the traffic manager routes the material by the most economical means which will effect delivery to the consignee by the time required. In making his routing determination, the traffic manager is guided by information which is supplied by the requisitioning officer at the time the material is originally requested. This data includes a notation as to the end use importance of the material, the deadline delivery date and, in the case of important cargo, an explanation as to the exact necessity for the use of premium transportation. This information serves as an indication to the supply activity of the need for expedited

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handling and is passed on to the traffic manager when the routing is requested. The traffic manager does two things in handling the case. First, he decides whether or not the shipment merits air transportation under existing conditions of airlift availability. Second, he issues a routing and assigns a transportation priority, which is a number, indicating the relative need of the shipment for expedited movement in comparison with with all other Navy freight moving in the military air cargo pipeline. It is an assignment of priority within an allocation of cargo airlift set aside for the Navy's use. The use of allocations makes it possible for each service to grade its own traffic and to accept material for air movement with the understanding that the particular carriers are obligated to provide the lift in a timely fashion. The allocation feature is most important to the success of any system of traffic management wherein capacity of the carrier is limited and speed in making operational decisions is vital.

After determination of routing, the information is passed back to the shipping activity together with a route order number. Both the boxes and the cargo documents are annotated with this information which, together with the bill of lading number, will identify the shipment to destination. The truck driver who delivers the cargo to the terminal is the next participant, followed, in turn, by the carrier's terminal personnel who receive the shipment and load it aboard the aircraft. From the ground-handling point of view, these are the people who are involved with the shipment before the cargo gets more than nine feet off the ground.

The Passenger/Cargo Airline Approach to Airfreight, by J. M. Glod, American Airlines, Inc., New York, N. Y. 1953 ASME Annual Meeting paper No. 53—A-236 (mimeographed).

ACCORDING to this paper, there is need for simplification in airfreight traffic practices. The tariffs and shipping documents required today are not conducive to fast receipt and/or delivery. They are not compatible with the airspeed of the plane itself. The dock techniques, for tariff and shipping documents, are almost as complex as surface. No one carrier or group of carriers is to blame for them; it was almost natural to follow surface practices, in principle, when airfreight was started. These are now habits which must be overcome and can only be overcome by intelligent and aggressive co-operation by those concerned. It is not going to be simple to resolve.

Another facet of simplification is warehousing and aircraft-loading equipment and procedures. There is little application of modern material-handling techniques, except on a very small scale. Little help has been received from manufacturers of cargo-handling equipment, probably because they haven't been asked, but also when some were asked they invariably began to "gadgeteer" and priced the article out of reach. Much progress has been made in the past year, but there is ample room for improvement.

Terminals need to be developed. There are only a few terminals that were specifically built for or had major modification made for airfreight. Most of the freight of all carriers is handled in whatever airport space may be available. This can only lead to inefficiency. In addition to layout based on maximum efficiency, getting all carriers under one roof at major terminals and avoiding steel and concrete construction (except for true structural purposes), are most important. Terminals must be flexible not only to allow expansion but must take into account the needs of the passenger/cargo airline without all-cargo planes; the passenger/cargo airline with cargo planes, and the all-cargo airlines.

Availability List of Unpublished ASME Papers

A NUMBER of papers and reports were presented at ASME Meetings which were neither preprinted nor published. Manuscript copies of these papers are on file for reference purposes in the Engineering Societies Library, 29 West 39th St., New York 18, N. Y. Photostatic copies of these unpublished papers may be secured from the Library at the rate of 40 cents per page. The following papers (including cost per photostatic copy) recently have been placed on file in the Engineering Societies Library:

1953 ASME Management Conference

Engineering Management and Top-Management Policy, by W. L. Cisler $3.20

1953 ASME Spring Meeting

Spark Testing, by Edsel E. Bishop 3.20

Some Engineering Aspects of Air Pollution Control, by George W. Blum 6.00

Industry's Stake in the Ohio Valley Program, by Edward J. Cleary 1.20

Human Relations Factors in the Estimating Procedure, by Marjorie B. Creelman 2.40

Mechanical Properties of High Mooney Elastomers, by P. J. Earley and M. J. Sanger 4.80

The Navy Looks at Structural Plastics, by W. R. Graner 6.80

Engineering—Opportunity Unlimited, by Everett S. Lee 2.80

Lincoln Incentive Management, by James F. Lincoln 2.00

The Integration of Theories of Organized Behavior, by R. T. Livingston and D. B. Hertz 3.20

Reinforced Plastics Connector Rings and Bolts for Fastening Timbers, by H. A. Perry, Jr. 3.20

Design of 180-Deg Partial Offset Journal Bearing, by Kwang-Tzu-Wang 3.20

ASME Transactions for January, 1954

THE January, 1954, issue of the Transactions of the ASME (available at $1 per copy to ASME members; $1.50 to nonmembers) contains the following:

Technical Papers

Performance of Free-Piston Gas Generators, by J. J. McMullen and W. G. Payne. (53—S-18)

The Free-Piston Type of Gas-Turbine Plant and Applications, by J. J. McMullen and R. P. Ramsey. (53—S-13)

The Application of Additives to Fuel Oil and Their Use in Steam-Generating Units, by J. B. McIlroy, E. J. Holler, Jr., and R. B. Lee. (52—A-160)

Chemical Cleaning in Central Stations, by P. H. Cardwell. (53—S-19)

An Interferometric Study of the Boundary Layer on a Turbine Nozzle Blade, by C. R. Faulders. (53—S-36)

The Solubility of Oxygen in Water, by L. M. Zoss, S. N. Suciu, and W. L. Sibbitt. (53—S-30)

Heat Transfer and Fluid Friction for Fully Developed Turbulent Flow of Air and Supercritical Water With Variable Fluid Properties, by R. G. Deissler. (53—S-41)

The Unsteady-Flow Water Tunnel at Massachusetts Institute of Technology, by J. W. Daily and K. C. Deemer. (53—S-31)

A Photographic Study of Events in a 14-In. Two-Cycle Gas-Engine Cylinder, by R. L. Boyer, D. R. Craig, and C. D. Miller. (53—S-45)

Phase-Plane Analysis—A General Method of Solution for Two-Position Process Control, by D. P. Eckman. (53—S-17)

Natural Frequency of a Nonlinear System Subjected to a Nonmassive Load, by C. E. Crede. (53—S-10)

Distribution of Shear-Zone Heat in Metal Cutting, by W. C. Leone. (53—S-7)

Transient Thermal Stresses in Circular Disks and Cylinders, by G. Horvay. (53—SA-51)

Comments on Papers

Including Letters From Readers on Miscellaneous Subjects

Financing Our Universities

To the Editor:

During the past ten years the privately endowed colleges and universities in the United States have found it increasingly difficult to finance their operations. Since the number of large personal estates upon which these institutions have always depended for endowments, have all but vanished, due to excessive taxation, the colleges are forced to look elsewhere for the financial support needed to carry on their work.

Two alternatives are readily available. First, they may seek governmental aid at either local or national level. Most institutions of higher learning take a dim view of this source, as it would mean an increase in an already prohibitive tax rate and the loss of their independence of action. Since it is generally conceded that what the Federal government can do for five dollars, private enterprise can do for one dollar, it would seem that the private colleges must turn to private enterprise, the users of their products, for support.

Trained brains essential

In our highly technical industrial economy, trained brains are as much a part of the process as the chemicals, metals, fuels, and fabrics going into the product. Iron ore remains iron ore until trained brains bring it together with the proper amounts of limestone, coke, and air in a blast furnace, whereupon, it promptly becomes iron. None of our large industries will deny the need for college-trained men in their organization. They would no more object to paying the producers of these trained men than they would object to paying for any other semifinished product.

The trained man, however, is different from materials which industry buys. He is not a machine that can be purchased, bolted to the floor, and kept there for his entire productive life. He still has the prerogative of changing employment whenever he chooses. Thus industry has no assurance that the semifinished product they have procured from our colleges will remain even until he has been turned into a finished product. For that reason, industry is justly hesitant about paying any reasonable sum to the college from which the new employee came. Further, a man leaving college has some forty productive years to live. Why should the first industry to employ him defray the major part of the deficit incurred in his education? Frankly, it should not. The deficit should be apportioned to all the employers over his entire productive life.

It is generally conceded that it costs a privately endowed college about $4000 above tuition charged to a student, to give him four years of training. This amount should be paid back to the college by the user of the graduate. Since a graduate has some forty years of productive life after graduation, the sum of $4000 should be paid to his Alma Mater at the rate of $100 per year. Let us suppose that graduates Jones and Smith are initially employed by the ABC Company. They both remained so employed for one year. At the end of that year, the ABC Company reimburses their Alma Mater $200. Six months later, Smith leaves ABC Company and is employed by XYZ Company for the remaining six months. Then two years after Jones and Smith graduated, their Alma Mater would receive $100 for Jones and $50 for Smith from the ABC Company and $50 from the XYZ Company for the six months Smith was employed by them.

How it would work

Thus a college graduating 500 students in June, 1953, will receive from the employers of those 500 graduates, the sum of $50,000 in June, 1954. If in June, 1954, an additional 500 students graduate, in 1955 the college would receive $50,000 for the students graduated in 1953 plus $50,000 for the students graduating in 1954, making a total of $100,000. Thus, if all the graduates live their allotted forty years and if the college continues to graduate 500 students per year, it will receive two million dollars in June of the forty-first year. This of course would be the maximum. The school would then continue to receive this annual sum as long as it graduated 500 students per year and as long as each lived and was gainfully employed his full forty years. The item of privately employed graduates need not be considered here as their number is very small, and there would be no objection from the schools should those so employed remit the annual $100 to their Alma Mater.

Not the complete answer

The plan suggested here is not a substitute for the large single contribution. Neither is it a complete answer to the present dilemma of college finance. It is believed, however, that should such a plan be adopted by the major part of the industry in the United States, within a very few years privately financed colleges and universities would have sufficient income to be able to attract the best scientists in all fields. This would result in better-trained and more valuable graduates for the ever-increasing complexity of our technology.

M. J. Charignon.[1]

High-Altitude and Speed Propulsion Wind Tunnel

Comment by Frank L. Wattendorf[2]

I am happy to have this opportunity to discuss this paper[3] since, although I agreed some time ago to participate, geographical separation during the past year prevented my coauthors from obtaining my planned contribution, as well as my criticism and comments on their manuscript.

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[1] Youngstown, Ohio. Mem. ASME.

[2] Technical Adviser, Aeronautical Research and Development, U. S. Air Force, Washington, D. C. Mem. ASME.

[3] "High-Altitude and Speed Propulsion Wind Tunnel at the Arnold Engineering Development Center, Tullahoma, Tenn.," by F. L. Wattendorf, J. Noyes, and A. I. Ponomareff, Mechanical Engineering, vol. 75, October, 1953, pp. 789–793.

The following remarks pertain to original USAF requirements and planning, and subsequent developments leading to the approval of this tunnel as one of the unitary plan wind tunnels, for the use not only of the USAF, but of industry and all military departments.

Requirements for a propulsion wind tunnel exceeding sonic speed became apparent to the USAF in 1943, when the advent of the jet engine in the European Theater brought greatly increased speed and mass-flow requirements to testing and development facilities. As an initial partial remedy of this situation, the Wind Tunnel Branch, Wright Field, in the spring of 1943, initiated a modification of the 10-ft sonic wind tunnel to make it capable of future operation at low supersonic speeds. About the same time the NACA also started planning supersonic propulsion facilities.

1944 New facility proposals

This was followed in 1944 by a series of new facility proposals at Wright Field, namely, an 8-ft × 12-ft supersonic aerodynamic wind tunnel by the Aircraft Laboratory; a large flow-generating system by the Power Plant Laboratory, capable of testing full-scale gas-turbine propulsion systems under simulated altitude conditions; a large subsonic wind tunnel for full-scale testing of propeller installations by the Propeller Laboratory; and a full-scale compressor testing stand by the Wind Tunnel Branch. Approval of all these proposals was withheld because of lack of sufficient power, water, and space at Wright Field.

In order to remedy the situation, the senior author in June, 1945, proposed to General F. O. Carroll, Chief, Engineering Division, AMC, that a new Air Force Research and Development Center be established, in a region of large power availability, to handle the testing requirements of supersonic aerodynamics and jet propulsion. Facilities were included in the proposed Center which more adequately would cover these needs than would the previously proposed Wright Field facilities, admittedly compromised by local limitations.

Approval received July, 1945

Approval for planning of this new Center was received from Headquarters, USAF, in July, 1945, and in December, 1945, a detailed proposal for an Air Engineering Development Center was submitted to Headquarters, USAF, by Colonel Kemmer and his Wright Field planning group.

In April, 1946, the Air Force plan was referred to a joint NACA-Army-Navy-Air Force-Industry Committee, under Arthur Raymond, to establish needs and co-ordinate planning of large supersonic testing facilities on a national rather than an organizational basis. Out of this committee and its successor, the so-called Unitary Wind Tunnel Plan resulted, under which all such facilities would be national in scope, and would be for the use of industry for development, and the military departments for evaluation. One of these Unitary Plan facilities, as approved and later modified after review by the RDB, is the propulsion wind tunnel, now being built at the Arnold Engineering Development Center, Tullahoma, Tenn., under the sponsorship of the USAF.

Testing full-scale jet-propulsion systems

This tunnel was designed for testing full-scale jet-propulsion systems under simulated flight conditions, in so far as possible, which includes the simulation of both internal and external flows, air speed, and altitude conditions. The greatly increased internal flow of the jet engine, as compared to the reciprocating engine, makes the balance between external and internal flows an important factor; supersonic-flow phenomena require equivalent Mach-number conditions; and altitude effects must be simulated, since combustion is affected critically by density. Full-scale tests are required since combustion processes are not subject to scaling down. Simulation of installation and immediate surroundings are necessary, because these items influence the balance between internal and external flow.

The size of the test section of the propulsion wind tunnel was chosen essentially from several considerations, namely, the testing of a full-scale turbojet in the transonic region from the viewpoint of desirable cross-sectional area; the testing of full-scale turboprops in the transonic region, with reasonably typical propellers; and the testing of full-scale ramjets in the supersonic region.

The stagnation pressure and temperature were chosen to simulate standard conditions of atmospheric air at altitude. Since a stagnation pressure equal to sea-level atmospheric pressure at the higher Mach numbers would have resulted in an excessively large minimum pressure altitude in the test section, provision was made for supercharging the wind tunnel to a stagnation pressure corresponding to reasonable simulation.

Once the test-section size, the Mach-number range, and the stagnation pressure are chosen, the power is essentially determined. The large power requirement, and the wide Mach-number range make the compressor design and fabrication unusually difficult, as can be seen from the description of my coauthors.

Tunnel for industrial and military use

To conclude this discussion, I would like to stress especially the fact that this tunnel is a national facility of the Unitary Wind Tunnel Plan, and as such is for the use of industry as well as all military departments. The design and construction of the tunnel has been an outstanding example of excellent co-operation from industry, the NACA, universities, research organizations, consultants, and the military departments. It is, therefore, an example of the encouraging trend toward co-operative effort on facilities for the common good.

Fees for Testing at National Bureau of Standards

To the Editor:

The report on the curtailment of the calibration and testing services of the National Bureau of Standards in Mechanical Engineering for October, 1953 (p. 854), recommends that "fees should be set so that costs of fact determinations by the Bureau are paid by those who need its services." I should like to explain that this is now done. However, the fees collected are required by law to be deposited in the Treasury and are not available to the National Bureau of Standards to defray the cost of doing the work. Thus a cut in the Bureau's appropriations necessarily means a curtailment in the services that can be rendered. In the present situation every effort is being made to provide essential standards and to discontinue no service unless adequate provision can be made to conduct it elsewhere.

A. T. McPherson.[4]

[4] Associate Director for Testing, National Bureau of Standards, Washington, D. C.

Reviews of Books

And Notes on Books Received in Engineering Societies Library

Billings and Water Power in Brazil

BILLINGS AND WATER POWER IN BRAZIL: A short biography of Asa White Kenney Billings, hydroelectric engineer. By Adolph J. Ackerman. Published by the author, Madison, Wis.; copublisher, American Society of Civil Engineers, New York, N. Y., 1953. Cloth, 7¼ × 10 in., illus., 128 pp., $7.

Reviewed by James K. Finch[1]

THIS is the story of an American engineer, Asa White Kenney Billings (1876–1949), a Harvard graduate, whose career was devoted to engineering works in foreign lands, notably Cuba, Spain, Mexico, and Brazil, and whose accomplishments were recognized by election to Honorary Membership in the ASCE in 1947. The writer found two sides of the story especially noteworthy. The book describes briefly Billings' hydroelectric work in Brazil which is of unusual technical interest. But it also inevitably raises the question of the prospects for American engineering talent and investment in foreign lands.

Unusual topography offers a special challenge to the hydroelectric engineer in Brazil. For some 1300 miles the southern coast of the country north of Uruguay is marked by a low coastline, back of which a steep escarpment breaks suddenly upward to an inland plateau some 1000 to 2500 ft above sea level. The main drainage of this interior region is not toward the coast but westward through its various tributaries to the Parana River which, roughly paralleling the coast, flows southward, some two or 300 miles inland, to finally reach the Atlantic in the Rio de la Plata at Buenos Aires. Here are inland streams of relatively large flow but moderate slope, which, could they be diverted eastward over the coastal escarpment of the Serra do Mar, could be developed under a head of a thousand feet or more.

Apparently, however, this possibility was not fully realized by earlier workers —possibly the power market, which centers in São Paulo, the "Chicago of South America," had not yet developed to the point where such a larger vision was justified. At any rate the first development in 1901 under Hugh L. Cooper on the Tietê River, a tributary of the Parana, was a typical run-of-river plant. It was reinforced in 1909 by a storage reservoir higher upstream, and a second plant, still higher up, was built in 1914 with a dam forming the Guarapiranga storage reservoir. It was Billings who, coming to Brazil in 1922, quickly grasped the possibilities of the site and developed and built the Cubatão power plant, which, operating under a head of 2350 ft, met the needs of the rapidly growing city of São Paulo. By increasing the height of older dams and building additional dams, new canals, and tunnels and by utilizing some of the lower head inland power for pumping, the flow was directed coastward and advantage was taken of this larger head to develop over forty times the power that the same flow would produce at the older interior plants. Further north at Fontes a similar development under a head of 1100 ft was undertaken for the supply of Rio de Janeiro.

As far as the writer knows we have no topography permitting similar undertakings in the United States. The nearest approach is the unique Rocky River plant on the Housatonic River above New Milford but this is a pure pumped-storage development.

As we have noted, this remarkably successful work of Billings in Brazil raises the question of the prospects for American engineers in foreign service. Unquestionably, the American engineer who is willing to make his life in a foreign country, perhaps giving up his United States citizenship—a temptation Billings resisted on, as he put it, "sentimental grounds"—may look forward to an interesting and successful career. On the other hand, it seems clear that we are in an era which may be characterized as one of technological nationalism. All nations are seeking to develop their own technological resources, human as well as material, in forwarding their economic and social evolution. American experts —Hammonds, Coopers, and Billings— may be called in "to start things" but it is quite naturally the hope and aim of each nation to build for itself.

It may also be questioned whether the experiences of recent years will not reflect adversely on the financing of such engineering projects by foreign capital. It seems inevitable that, sooner or later, any nation will seek to own its own industrial and other economic machinery. These Brazilian power developments were financed by Canadian capital and one of Billings' major tasks became that of convincing government officials that Brazil needed such foreign aid if its power services were to keep pace with its growing needs. It remains to be seen, therefore, whether the present administration in Brazil, which is decidedly nationally minded, will continue to permit such foreign investments or may not simply expropriate these most interesting hydroelectric developments.

[1] Dean emeritus and Renwick Professor emeritus of civil engineering, Columbia University, New York, N. Y.

Books Received in Library . . .

EISENBAHNBRUCKEN AUS SPANNBETON. (Deutscher Ausschuss für Stahlbeton, Heft 112). By Reichsbahnrat Bühnrat Buhrer. Wilhelm Ernst & Sohn, Berlin, Germany, 1953. 67 p., 11¾ × 8¼ in., paper. DM. 8. This report on experiences in the construction of prestressed-concrete railroad bridges presents the results of tests and measurements made on four existing structures and on test pieces. Tables and graphs are extensively used in the presentation of the data.

FAMOUS BRIDGES OF THE WORLD. By D. B. Steinman. Random House, New York, N. Y., 1953. 99 p., 10¼ × 8 in., bound. $1.75. A simple, well-illustrated, narrative account, by a well-known bridge designer, of the development of the art and science of bridge building. Famous bridges of various periods are described as notable examples of the major types. Basic general information is also included in a manner suitable for the young reader as well as the interested adult.

INTRODUCTION TO AERONAUTICAL DYNAMICS. By Manfred Rauscher. John Wiley & Sons, Inc., New York, N. Y., 1953. 664 p., 10 × 6¾ in., bound. $12. Intended as a two-semester course for undergraduates, this text provides a thorough coverage of particle dynamics, fluid dynamics, airfoil theory, rigid dynamics, and vibration analysis. The

detailed analytical treatment is kept within the range of the students' mathematical background, the main object being to lay a solid foundation, along with the applied course, for the subsequent study of aircraft stability.

JAPAN'S NATURAL RESOURCES AND THEIR RELATION TO JAPAN'S ECONOMIC FUTURE. By Edward A. Ackerman. University of Chicago Press, Chicago, Ill., 1953. 655 p., $10^1/_4 \times 7^1/_2$ in., bound $25. A study of the country's physical endowments, including mineral industries, energy sources, and water supply, in relation to the basic human needs of the population, and of the possibilities of integrated resource management. An analysis of the character of resources and requirements is followed by suggestions as to advances in the efficiency of resource use and associated problems and by a discussion of Japan's position in relation to the western world. Excellent photographs, maps, charts, and tables make this valuable for reference.

ASME BOILER CODE

Interpretations

THE Boiler Code Committee meets monthly to consider "Cases" where users have found difficulty in interpreting the Code. These pass through the following procedure: (1) Inquiries are submitted by letter to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.; (2) Copies are distributed to Committee members for study; (3) At the next Committee meeting interpretations are formulated to be submitted to the ASME Board on Codes and Standards, authorized by the Council of the Society to pass upon them; (4) They are submitted to the Board for action; (5) Those which are approved are sent to the inquirers and are published in MECHANICAL ENGINEERING.

(The following Case Interpretations were formulated at the Committee meeting October 30, 1953, and approved by the Board on January 12, 1954.)

CASE NO. 1164-1 (REOPENED)

(Special Ruling)

Inquiry: When carbon steel plates, forgings, pipes, tubes, and castings conforming to an approved specification and having a specified minimum yield strength of 30,000 psi are used for the construction of vessels under external pressure, under what rules shall they be designed and fabricated?

Reply: It is the opinion of the Committee that carbon steel plates, forgings, pipes, tubes, and castings that conform to the requirements of an approved specification and have a specified yield strength of at least 30,000 psi may be used for the construction of vessels under external pressure and the vessels may be stamped with the Code symbol provided the following requirements are complied with:

(1) The applicable rules in the 1952 Edition of Section VIII of the Code covering vessels under external pressure when constructed of carbon steel shall be adhered to;

(2) The thickness of shells and heads and the required moment of inertia for stiffening rings shall be determined from the chart in Fig. UCS-28.2.

(*Note:* The chart in Fig. UCS-28.2, "Chart for Determining Shell Thickness of Cylindrical and Spherical Vessels Under External Pressure When Constructed of Carbon Steel (Specified Yield Strength 30,000 to 38,000 Psi)" is the same chart published previously as Addenda to 1952 Sec. VIII for carbon steel with specified yield strength 31,000 to 40,000 psi; it will also be included in the published Interpretations.)

CASE NO. 1177

(Special Ruling)

Inquiry: Expansion joints are being used in pressure vessel installations. The Code makes no specific provisions for them. Under what conditions may an expansion joint be used as an integral part of a Code pressure vessel?

Reply: It is the opinion of the Committee that, pending the adoption of Code rules for expansion joints, they may be used as integral parts of Code pressure vessels provided they satisfy the following conditions:

(1) The combined bending and direct stress due to flexing and pressure in the flexing elements shall be controlled as follows:

The manufacturer of the joint shall submit to the authorized inspector satisfactory evidence, in the form of certified test data supplemented by service records if applicable and available, that:

(I) The joint will withstand the hydrostatic test prescribed for the vessel;

(II) The joint, while subject to the design pressure and design temperature, will withstand four times the number of design amplitude direct flexings or other form of movement required by the purchaser of the vessel;

(III) The joint, while at the design temperature, is capable of withstanding a single application of four times the design pressure without rupturing the joint and regardless of the amount of distortion.

(2) All of the requirements of Part UW of the 1952 Section VIII with the exception of the higher stresses implied in (1) of the Reply, shall be complied with.

(3) The expansion joint shall not be stamped with the Code symbol but, in addition to the certified data of (1) of this Reply, the manufacturer of the joint shall execute a partial data report as required by Par. UG-120(b) using Form U-2 in so far as applicable, in order that the final inspector of the completed vessel may have the information necessary to satisfy him that the expansion joint is adequate for the vessel in which it is to be used and that the materials and welding are in accordance with Code rules.

The certified data of (1) of this Reply and the partial data report shall be the final inspector's authority to witness the application of a Code symbol to the completed vessel.

CASE NO. 1178

(Interpretation of Tables A-5, A-6, and P-15 of Section I and Tables UA-451 and UA-452 of Section VIII)

Inquiry: Section I, Tables P-15, A-5 and A-6; Section VIII, Tables UA-451 and UA-452 contain pressure-temperature ratings for flanged fittings, flanges, and valves produced in accordance with ASA B16e–1949 Supplement No. 1. This standard has been revised and reissued as ASA B16.5–1953. May the pressure-temperature ratings contained in the revised standard be used in place of the tables currently in the Code?

Reply: It is the opinion of the Committee that the pressure-temperature ratings contained in ASA B16.5–1953 meet the intent of the Code, and may therefore be used.

CASE NO. 1179

(Special Ruling)

Inquiry: When nickel, nickel-copper alloy, or nickel-chromium-iron alloy plates, sheets, pipes, tubes, and shapes conforming to an approved specification are used for the construction of vessels under external pressure, under what

rules shall they be designed and fabricated?

Reply: It is the opinion of the Committee that nickel, annealed nickel-copper alloy, or annealed nickel-chromium-iron alloy plates, sheets, pipes, tubes, and shapes that conform to the requirements of an approved specification may be used for the construction of vessels under external pressure and the vessels may be stamped with the Code symbol provided the following requirements are complied with:

(1) The applicable rules in the 1952 Edition of Section VIII of the Code covering vessels under external pressure when constructed of nonferrous materials shall be adhered to.

(2) The thickness of shells and heads, and the required moment of inertia for stiffening rings shall be determined from the charts in Fig. UNF-28.6 for nickel, Fig. UNF-28.7 for annealed nickel-copper alloy, or Fig. UNF-28.8 for annealed nickel-chromium-iron alloy.

(*Note:* The following charts are available from the Secretary of the Boiler Code Committee, and will also be included in the published Interpretations:

Fig. UNF-28.6—Chart for Determining Shell Thickness of Cylindrical and Spherical Vessels Under External Pressure When Constructed of Nickel

Fig. UNF-28.7—Chart for Determining Shell Thickness of Cylindrical and Spherical Vessels Under External Pressure When Constructed of Annealed Nickel-Copper Alloy

Fig. UNF-28.8—Chart for Determining Shell Thickness of Cylindrical and Spherical Vessels Under External Pressure When Constructed of Annealed Nickel-Chromium-Iron Alloy.)

Case Annulled

Case No. 1154 can be annulled as a result of the revision to Table UCS-23 of Sec. VIII (below).

Proposed Revisions and Addenda to Boiler and Pressure Vessel Code . . .

As NEED arises, the Boiler Code Committee entertains suggestions for revising its Codes. Revisions approved by the Committee are published here as proposed addenda to the Code to invite criticism. If and as finally approved by the ASME Board on Codes and Standards, and formally adopted by the Council, they are printed in the annual addenda supplements to the Code. Triennially the addenda are incorporated into a new edition of the Code.

In the following the paragraph numbers indicate where the proposed revisions would apply in the various sections of the Code.

Comments should be addressed to the Secretary of the Boiler Code Committee, ASME, 29 West 39th Street, New York 18, N. Y.

Material Specifications, 1952

The Boiler Code Committee has approved adding to Section II the following new specifications:

SA-6-52aT
SA-20-52T

The following four specifications have been superseded by SA-335-52aT:

SA-158-51T
SA-206-51T
SA-280-51T
SA-315-51T

Specification SA-157-50T has been superseded by SA-351-52T.

Unfired Pressure Vessels, 1952

MEMBERS OF COMMITTEES Add "George S. Chadwick, Jr." to the membership of the Subcommittee on Unfired Pressure Vessels.

CONTENTS "APPENDIX A—Porosity Charts" should be listed under the Mandatory Appendixes as "APPENDIX IV—Porosity Charts." The change from "Appendix A" to "Appendix IV" should be made in Par. UW-51(m)(4) and throughout.

PAR. UG-32(l) Revise to read:

(l) An ellipsoidal, torispherical, or toriconical head which is attached to a shell by a butt joint need not be provided with a skirt when the nominal head thickness does not exceed $1\frac{1}{4}$ times the nominal shell thickness. When the nominal head thickness exceeds $1\frac{1}{4}$ times the nominal shell thickness, a skirt shall be provided having a length not less than three times the nominal head thickness, or $1\frac{1}{2}$ in., whichever is smaller. When a skirt is used it shall meet the requirements for shell thickness in Par. UG-27(c).

PAR. UG-41(d) In line 3, change "section" to "parts."

PAR. UG-44 Revise the last sentence to read: "Other flanges shall be designed in accordance with the rules in Appendix II, except that flanges within the size and pressure ranges of the above Standards may be designed by interpolation."

PAR. UG-45 Revise subparagraph (1) to read:

(1) The required thickness of the shell or head, assuming $E = 1$, plus the design corrosion allowance.

PAR. UG-99(g) Revise to read: "Following the application of the hydrostatic test pressure an inspection shall be made of all joints and connections. This inspection shall be made at a pressure not less than $\frac{2}{3}$ of the test pressure."

PAR. UG-101(o) Change "deformation" to "displacement" in the first line of subparagraph (3) and the fourth line of subparagraph (4).

FIG. UW-9(c) Change "Hemispherical Shape" to "Heads Thinner Than Shell."

PAR. UW-2(b) Revise the first sentence to read: "Vessels that are to operate below −20 F shall have all longitudinal and circumferential joints of the double-welded butt type or its equivalent when impact tests in accordance with Par. UG-84 are required for the material or weld metal."

TABLE UW-12 In footnote 4, change "UA-61" to "UA-60."

FIG. UW-16.1 This figure has been revised; copies can be obtained from the Secretary of the Boiler Code Committee, and will also be included in the published Addenda.

FIG. UW-16.2 A minor change has been made in the dimensioning of this figure; copies can be obtained from the Secretary of the Boiler Code Committee, and will also be included in the published Addenda.

PAR. UW-16 Revise to read:

UW-16 Minimum Requirements for Attachment of Welds (a) *General* The location and minimum size of attachment welds for nozzles and other connections shall conform to the requirements in this paragraph.

(b) *Symbols* The notations used in this paragraph and in Figs. UW-16.1 and UW-16.2 are defined as follows:

t = nominal thickness of vessel shell or head less corrosion allowance, inches;

t_n = nominal thickness of nozzle wall less corrosion allowance, inches;

t_e = thickness of reinforcing element, inches;

t_w = dimension of partial-penetration attachment welds (fillet, single-bevel, or single-J), measured as shown in Fig. UW-16.1, inches,

t_c = the smaller of $\frac{1}{4}$ inch or 0.7 t_n (inside corner welds may be further limited by a lesser length of projection of the nozzle wall beyond the inside face of the vessel wall);

t_{min} = The smaller of $\frac{3}{4}$ inch or the thickness less corrosion allowance, of either of the parts joined by a fillet, single-bevel, or single-J weld, inches;

t_1 or t_2 = not less than $\frac{1}{2}\ t_{min}$ or $\frac{1}{4}$ inch.

(c) *Necks Abutting the Vessel Wall* Necks abutting the vessel wall shall be attached by a full-penetration groove weld. Backing strips shall be used with welds deposited from only one side when the shell thickness is over $\frac{3}{8}$ in. or when complete joint penetration cannot be verified by visual inspection. (See Fig. UW-16.1(a) and (b).)

Necks or tubes recessed into thick-walled vessels or headers may be welded from only one side by cutting a welding groove in the vessel wall to a depth of not less than t_n on the longitudinal axis of the opening. It is recommended that a recess $^1/_{16}$ in. deep be provided at the bottom of the groove in which to center the nozzle. The dimension, t_w, of the attachment weld shall be not less than t_n or less than $^1/_4$ in. (For examples see Figs. UW-16.1(y) and (z).)

(d) *Inserted Necks Without Added Reinforcing Elements* Necks inserted into or through a hole cut in the vessel wall and without additional reinforcing elements shall be attached by a full-penetration groove weld or by two partial-penetration welds, one on each face of the vessel wall. Permissible types of welds are shown in Fig. UW-16.1(c) to (h).

Backing strips shall be used with full-penetration welds deposited from only one side when the shell thickness is over $^3/_8$ in. or when complete joint penetration cannot be verified by visual inspection. The two partial-penetration welds may be any desired combination of fillet, single-bevel, and single-J welds. The dimension t_w to each weld shall be not less than $^1/_2\ t_{min}$ nor less than $^1/_4$ in. and their sum shall be not less than $1^1/_4\ t_{min}$. (See Fig. UW-16.1.)

(e) *Inserted Necks With Added Reinforcement* Inserted-type necks having added reinforcement in the form of one or more separate reinforcing plates shall be attached by welds at the outer edge of the reinforcement plate and at the nozzle-neck periphery. The weld at the outer edge of the reinforcement shall be a fillet weld with a minimum throat dimension of $^1/_2\ t_{min}$. The welds attaching the neck to the vessel wall and to the reinforcement shall consist of one of the following combinations:

(1) A single-bevel or single-J weld in the shell plate, and a single-bevel or single-J weld in each reinforcement plate. The dimension, t_w, of each weld shall be not less than 0.7 t_{min} (Fig. UW-16.1(n)).

(2) A full-penetration groove weld in the shell plate, and a fillet, single-bevel or single-J weld with a weld-dimension, t_w, not less than 0.7 t_{min} in each reinforcement plate (Fig. UW-16.1(m)).

(3) A full-penetration groove weld in each reinforcement plate, and a fillet, single-bevel, or single-J weld with a weld-dimension, t_w, not less than 0.7 t_{min} in the shell plate (Fig. UW-16.1(l)).

(f) *Nozzles With Integral Reinforcement* Nozzles and other connections having integral reinforcement in the form of extended necks or saddle-type pads shall be attached by a full-penetration weld or by means of a fillet weld along the outer edge and a fillet, single-bevel, or single-J weld along the inner edge. The throat dimension of the outer weld shall be not less than $^1/_2\ t_{min}$. The dimension, t_w, of the inner weld shall be not less than 0.7 t_{min} (see Fig. UW-16.1(k), (r), (s) and (t)).

(g) *Fittings With Internal Threads.* The attachment of internally threaded fittings shall meet the following requirements:

(1) Except as provided for in (2), (3), and (4), internally threaded fittings shall be attached by a full-penetration groove weld, or by two fillet or partial-penetration welds, one on each face of the vessel wall. The minimum weld dimensions shall be as shown in Fig. UW-16.1(u), (v), (w), and (x).

(2) Fittings shown in Fig. UW-16.1 (u-2), (v-2), (w-2), and (x) not exceeding 3 in. pipe size may be attached by welds that are exempt from size requirements other than those specified in Par. UW-15(a).

(3) Internally threaded fittings or equivalent bolting pads not exceeding 3 in. pipe size may be attached to vessels having a wall thickness not greater than $^3/_8$ in. by a fillet weld deposited from the outside only, having the minimum dimensions shown in Fig. UW-16.2.

(4) Internally threaded fittings not exceeding 3 in. pipe size may be attached by a fillet groove weld from the outside only as shown in Fig. UW-16.1(w-3). The groove weld t_w shall not be less than the thickness of schedule 160 pipe (ASA B36.10–1950).

Fig. UW-19.1 Delete diameter of staybolt $d = ^7/_8$" max from each of drawings (a), (b), (c), (d), and (e).

Par. UW-52(g) In the second line of the second column, change "operator" to "welder."

Table UCS-23 In the stress values for Low-Alloy Steels SA-193-B7, add "8500" in the 950 F column and "4500" in the 1000 F column.

Par. UCS-28(a) Revise to read:

(a) Cylindrical and spherical shells under external pressure shall be designed by the rules in Par. UG-28, using Fig. UCS-28.

Par. UCS-56(a)(1) Add "SA-301 Grade B" and change "SA-302 Grade B" to "SA-302."

Par. UCS-56(a)(2) Add "SA-301 Grade A."

Par. UNF-28(a) Revise to read:

(a) Cylindrical and spherical shells under external pressure shall be designed by the rules in Par. UG-28, using Fig. UNF-28.

Par. UHA-28(a) Revise to read:

(a) Cylindrical and spherical shells under external pressure shall be designed by the rules in Par. UG-28, using Fig. UHA-28.

Par. UCI-28(a) Revise to read:

(a) Cylindrical and spherical shells under external pressure shall be designed by the rules in Par. UG-28, using Fig. UCI-28.

Par. UA-250 Delete subparagraph (d).

Par. UA-276(a) In the last line of Step 1, change "2.44" to "244."

Par. UA-48(a)(3) Revise to read: "This classification covers types of construction where the attachment of the flange to the neck or vessel wall is such that the assembly is considered to act as a unit which should be calculated as an integral flange. For simplicity the designer may calculate the construction as a loose-type flange provided none of the following values is exceeded:

$g_o = ^5/_8$ in.; $\frac{B}{g_o} = 300$; $P = 300$ psi, operating temperature = 700 F."

Par. UA-280 Revise Example 4 to read:

Example 4

A 16-inch, 600-pound welding-nozzle conforming to Specification SA-105, Grade II, is attached to a vessel that has an inside diameter of 96 in. and a shell-thickness of 2 in. The shell-material conforms to Specification SA-212, Grade A. The vessel operates at 425 psi and 800 F. An allowance of $^1/_{16}$ in. for corrosion is included in the shell and nozzle thickness. The vessel is stress-relieved and radiographed. Check the adequacy of the attachment welds shown in Fig. UA-280.4.

Wall thickness required

Shell t_r

$$= \frac{425 \times 48.06}{11{,}400 \times 1.0 - 0.6 \times 425} = 1.833 \text{ in.}$$

Nozzle t_{rn}

$$= \frac{425 \times 8.06}{11{,}400^* \times 1.0 - 0.6 \times 425} = 0.308 \text{ in.}$$

Size of weld required (see Par. UW-16(f))

Outer perimeter weld =

$$1.41 \times 0.5 \times 0.75 = 0.53 \text{ in.}$$

Inner perimeter weld =

$$0.7 \times 0.75 = 0.53 \text{ in.}$$

The weld sizes used are satisfactory.

Area of reinforcement required

$$A = 16.125 \times 1.833 = 29.56 \text{ sq. in.}$$

Area of reinforcement provided

$A_1 = 16.125(1.937 - 1.833) = 1.68$ sq in.
$A_2 = 2 \times 4.84(1.687 - 0.308) = 13.35$ sq in.
$A_3 = 2 \times ^1/_2 \times (0.75)^2 = 0.56$ sq in.

$$A_4 = 2 \times 2.0 \frac{(26 - 19.5)}{2} + 2 \times \frac{1.5}{2} \times \frac{(26 - 19.5)}{2} = 17.87 \text{ sq in.}$$

Total area furnished = 33.46 sq in.

Load to be carried by welds (Par. UG-41(b)(2))

$$W = (29.56 - 1.68)11{,}400 = 317{,}800 \text{ lb}$$

Unit stresses

Shear in fillet weld =

$$0.49 \times 11{,}400 = 5590 \text{ psi}$$

Shear in groove weld =

$$0.60 \times 11{,}400 = 6840 \text{ psi}$$

Strength of connection elements

A Fillet weld in shear =
$1.57 \times 26.0 \times 0.75 \times 5590 = 171{,}100$ lb

B Groove weld in shear =
$1.57 \times 17.0 \times 0.875 \times 6840 = 159{,}700$ lb

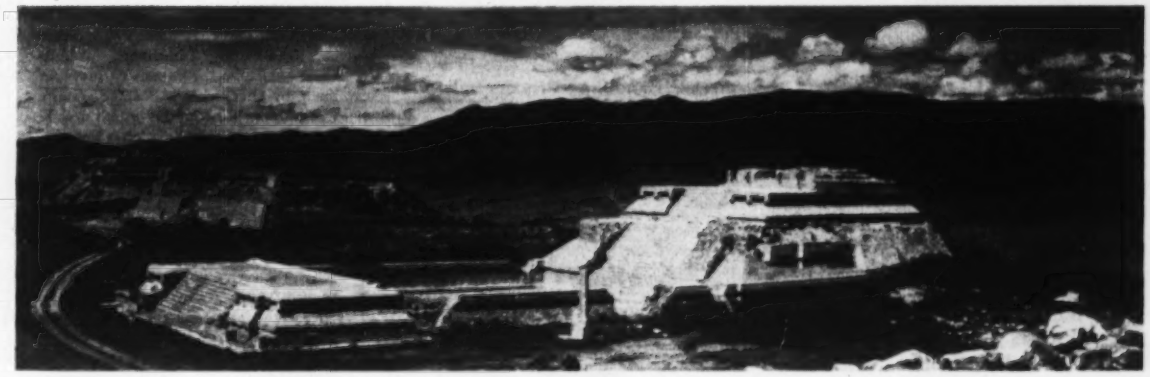
The connection elements A and B have a design strength of 330,800 lb, which exceeds the required strength of 317,800 lb.

* See Par. UG-41(a).

Par. UA-500 In the first line of the second paragraph on page 162, insert "the" before "transition."

ASME NEWS

With Notes on the Engineering Profession



A high spot of the tour, the ancient ruins of the Indian pyramids at Monte Alban in Oaxaca, Mexico

Program Announced for 1954 International Meeting and Tour of Mexico

Hotel Del Prado Headquarters, March 10—12, Tour Includes Mexico City, Cuernavaca, Taxco, Xochimilco, and Acapulco

THE tour which has been so carefully arranged step by step in conjunction with the 1954 ASME International Meeting to be held at the Hotel Del Prado, Mexico, D. F., is now a reality. Transportation schedules have been completed; hotel reservations at Del Prado, Bamer, and Prince are confirmed; and the tour of Mexico City, Cuernavaca, Taxco, Xochimilco, and Acapulco is bound to be the high spot of the year.

To avoid disappointment later, ASME members who are planning on the trip are urged to make their reservations now. A deposit of $25 for each member of a party, or individuals traveling alone, will assure a reservation. Write to Mr. Ernest Hartford, Deputy Secretary ASME, 29 West 39th Street, New York 18, N. Y., describing precisely the type of accommodations required, enclosing check in the required amount, with the understanding that, if necessary, cancellation and refund will be possible at least until February 22 at headquarters in New York.

American Airlines is handling transportation which guarantees a professionally conducted tour. Through-plane connections from New York, N. Y., Chicago, Ill., and Los Angeles, Calif., are regular flight service. Members residing elsewhere can readily ascertain connection data by calling local representatives of American Airlines or writing to Mr. Hartford.

The rates have been worked out from New York, N. Y.; for example, Family Plan, first-class fare, $250.82 for two one-way tickets, tax included. Round-trip Family Plan is twice this amount. Tourist Plan is $113.85 per person each way, tax included. Regular fare, for those traveling alone first class, or leaving on other than Monday, Tuesday, or Wednesday, is $312.11 round trip, tax included.

The total rate for the entire tour in Mexico from arrival on March 8 until departure from Mexico City on March 17, per person for double-room accommodation, $165; single-room $180, minus or plus, depending on the hotel chosen, plus air fare from home to Mexico City.

Mexico—starting with the capital city, one is impressed with its many contrasts of ancient and modern side by side, its cathedrals, the Government Palace famed for murals by Diego Rivera, and the Shrine of Guadalupe. Then travel on to the fabulous Pyramids of the Sun and Moon, the Toltec Temple of Quetzalcoatl, the grotesque stone serpents, and other relics of a lost civilization. During the meeting, sight-seeing will be conducted in the afternoon. Ample time is allowed for the discovery of the buyer's paradise that reaches all the way from Mexico City's aristocratic shops of the Avenida Juarez and Paseo de la Reforma to the cobbled streets and native markets of Taxco, noted for hand-wrought silver. And now with the favorable-to-you exchange rate the dollars stretch to afford shopping sprees for Mexican treasures.

Inspection trips have been planned to include the major industries of Mexico in this area.

To this point the visiting has been confined to the vicinity of the capital—now the tour leaves Mexico City for a scenic drive to Cuernavaca, the enchanting summer resort; then a drive over the majestic Sierra Madre Occidental to the Hacienda Vista Hermosa; and later driving on to see Taxco where silver, for which this picturesque town is famous, is fashioned into everything from the tiniest charms to the most massive pieces by native craftsmen. Here is also to be seen the Casa Figeroa and the Cathedral of Santa Prisca.

A day to remember will be spent at Xochimilco cruising along in a flower-bedecked boat past the floating gardens surrounded by fragrant flowers and soft music, returning to Mexico City in time for the spectacle of the Continent—the bullfight.

Then away to Acapulco by air to enjoy the famous, breathtakingly scenic beaches, deep-sea fishing, and the exotic atmosphere of this remote town so reminiscent of the South Seas. It is a little like Hawaii, something like the Riviera, and yet so different.

Just as carefully as the tour has been planned for complete enjoyment, so diligently has the International Meeting been designed. The technical sessions present an excellent opportunity to exchange professional ideas with a "foreign" flavor; the luncheons and banquet a chance to cement long-distance friendships; and the inspection trips a firsthand view of how the other fellow conquers the problems.

The tentative program for the International Meeting follows:

WEDNESDAY, MARCH 10

9:00 a.m.

Registration

10:00 a.m.

Official Inauguration

1:00 p.m.

President's Luncheon

Presiding: To be announced
Speaker: *L. K. Silcox*, ASME President
Subject: **The Meaning of Mexico**

4:00 p.m.

Process Industries (I)

Black-Liquor Recovery Sulphate Pulp Mill, by Ing. *José De La Macorra*, Cia de Las Fabricas de Pupel de San Rafael y Anexas S. A.

Engineering of Vacuum-Filter Station in Cane-Sugar Factories, by *Lloyd Jacobsen*, Oliver United Filters, Inc.

4:00 p.m.

Oil & Gas Power (I)—Railroad

Successful Applications of Standard Diesel Electric Power to Foreign Railroads, by *Manuel Alonso*, American Locomotive Co.

Diesel-Plant Design—Influence of Fuels and Higher Engine Ratings, by *Robert Cramer, Jr.*, Nordberg Manufacturing Co.

4:00 p.m.

Mexico Section

A Contribution to the Knowledge of Pressure Measurements During Metal Deformation, by *Joseph Firsch*, University of California

A New Approach to Metal-Forming Problems—Experimental Stress Analysis for a Tubular Extrusion, by *E. G. Thomsen*, University of California

7:30 p.m.

Fiesta Mexicana

A get-together party at the Rancho del Artista in the old suburb of Coyoacan

THURSDAY, MARCH 11

9:00 a.m.

Registration

10:00 a.m.

Lubrication Activity—Oil & Gas Power (II)

Factors Affecting Oil-Drain Practices for Diesel Engines, by *John C. Gibb* and *L. F. Moody, Jr.*, Socony-Vacuum Oil Co., Inc. (Paper No. 54—Mex-3)

10:00 a.m.

Process Industries (II)

Performance Characteristics of a Refrigerating Plant by Electric-Analog Analysis, by *Carl F. Kayan*, Columbia University

Frasch Sulphur Mining, by *James Woodburn*, Rice Institute

10:00 a.m.

Inspection Trips

Lecheria Steam Electric Station
Cia. Hulera Goodyear Oxo, S. A.
Guanos y Fertilizantes, S. A.
Distribuidora Mexicana, S. A.—D. A. Nacional
La Consolidada, S. A.

3:00 p.m.

Materials Handling—Process Industries (III)

Conveying Equipment in Cane-Sugar Mills, by *C. Rinelli*, Chain Belt Co. (Paper No. 54—Mex-2)

Grinding Capacities of Cane-Sugar Mills, by *José M. Cabrera*, Member of Mexican Government Committee for the Reorganization of the Mexican Sugar Industry

3:00 p.m.

Hydraulic

The Mechanism of Cavitation Inception and the Related Scale-Effects Problem, by *Robert W. Kermeen, John T. McGraw*, and *Blaine R. Parkin*, California Institute of Technology (Paper No. 54—Mex-1)

The San Bartolo Impulse Wheel, by *Javier Fuentes, Salvador Almanza*, Comision Federal de Electricidad, and *William J. Rheingans*, Allis-Chalmers Manufacturing Co.

3:00 p.m.

Education—Junior

The Education of Mechanical and Electrical Engineers, by *Ignacio Avilet*, Diesel National

The ASME Juniors and Professional Development, by *Robert Nelsen*, General Electric Co.

The First Five Years of Professional Development, by *Karl B. McEachron*, General Electric Co.

3:00 p.m.

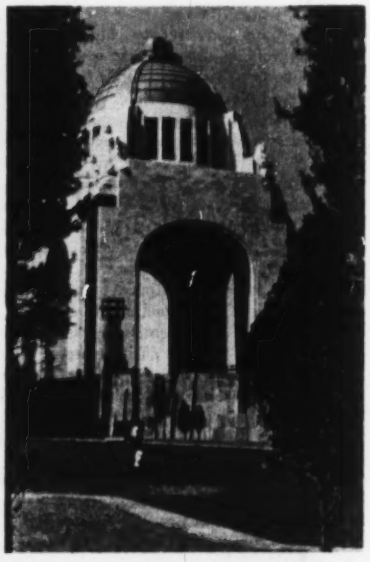
Inspection Trips

Tacubaya Diesel—Electric Plant
Cementos Mixcoac, S. A.
Fabrica de Papel Loreto y Pena Probe, S. A.

7:30 p.m.

Banquet

Presiding: J. K. Jennings
Speaker: To be announced
Subject: To be announced



Striking Monument to the Revolution, Mexico City

Preprint Orders

ONLY preprints of numbered papers will be available. The final listing of available technical papers will be found in the issue of MECHANICAL ENGINEERING containing an account of the meeting. Preprints of ASME papers may be obtained by writing to the ASME Order Department, 29 West 39th Street, New York 18, N. Y. Papers are priced at 25 cents each to members, 50 cents to nonmembers. Payment may be made by check, U. S. postage stamps, free coupons, or coupons which may be purchased from the Society. The coupons, in lots of ten, are $2 for members, $4 for nonmembers.

Preprints of unnumbered papers, listed in the tentative program, are not available because the review of these manuscripts had not been completed when the program went to press. The preprint number will appear with paper title in the final program (final program available only at meeting) as well as the issue of MECHANICAL ENGINEERING containing an account of the meeting, if the paper is recommended for preprinting.

FRIDAY, MARCH 12

9:00 a.m.

Registration

10:00 a.m.

Power (I)

Electric-Power Production in the United States, by *Charles W. E. Clark* and *Walter P. Gavit*, United Engineers & Constructors, Inc. (Paper No. 54—Mex-7)

The Maintenance and Operation of the Tacubaya Diesel Plant, by *J. K. Jennings*, Mexico Light & Power Co., Ltd.

10:00 a.m.

Petroleum

Recent Mechanical-Engineering Developments in Petroleum Production, by *E. N. Kemler*, University of Minnesota

Recent Mechanical-Engineering Developments in Petroleum Transportation, by *A. H. Newberg*, Service Pipe Line Co.

Recent Mechanical-Engineering Developments in Petroleum Refining, by *J. S. Rearick*, The M. W. Kellogg Co.

10:00 a.m.

Inspection Trips

Industria Electrica de Mexico, S. A.
Reynolds International de Mexico, S. A.
Cia. Nacional de Refractarios A. P. Green, S. A.
General Motors de Mexico, S. A. de C.V.
Cervecería Modelo, S. A.
Colgate y Palmolive Peet, S. A.

1:00 p.m

Despedida Luncheon

3:00 p.m,

Fuels—Power (II)—Process Industries (IV)

Bagasse as a Fuel for Steam Generation, by *Francis D. Wilson*, The Babcock & Wilcox Co. (Paper No. 54—Mex-6)

Bagasse Burning in the Mexican Sugar Industry, by *Otto de Lorenzi*, Combustion Engineering, Inc. (Paper No. 54—Mex-4)

The Spreader Stoker in the Sugar Industry, by *Earle C. Miller*, Riley Stoker Corp. (Paper No. 54—Mex-5)

3:00 p.m.

Instruments & Regulators

A Recent Development in the Measurement of the Sugar-Supersaturation Coefficient, by *R. L. Müller,* Minneapolis-Honeywell Regulator Co.

Process Instrumentation in England and Europe, by *Porter Hart,* The Dow Chemical Co.

3:00 p.m.

Inspection Trip

Petroleos Mexicanos (PEMEX)

WOMEN'S PROGRAM

WEDNESDAY, MARCH 10

10:00 a.m.: Official Inauguration

1:00 p.m.: President's Luncheon

7:30 p.m.: Fiesta Mexicana

THURSDAY, MARCH 11

9:00 a.m.: *San Angel house and garden tour*—San Angel is one of the oldest and most beautiful residential sections of Mexico City. There are many fine old colonial as well as modern homes and gardens located in this section. It is a rare privilege to offer an opportunity to visit several of these private residences. The proceeds from this visit will be for the benefit of a home for crippled children.

1:00 p.m.: *Jockey Club, Hipodromo de las Americas*—The Hipodromo is one of the most interestingly landscaped horse-racing tracks in the Western Hemisphere. The exclusive Jockey Club has made its luxurious facilities available on this regular racing day. Lunch is included.

7:30 p.m.: *Banquet*

FRIDAY, MARCH 12

9:00 a.m.: *Shopping Tour, including visits to glass, leather, and silver factories.* It is suggested that shopping be delayed until after this tour of the City's art-work factories. The beauty and variety of the articles for sale makes for a souvenir-hunter's paradise.

1:00 p.m.: *Despedida Luncheon*

4:00 p.m.: *Style Show (Modern Mexican).* This event is to be held in a beautiful garden and all of the clothes shown will have been made in Mexico. Featured will be Mexican style resort wear, beach wear, and more formal fashions by several leading stylists. There is a swimming pool available for use during the afternoon. Tea or cocktails will be served.

Availability List

THE papers included in the "Availability List," published in the January, 1954, issue of MECHANICAL ENGINEERING for the 1953 Annual Meeting, are available in separate copy form until Oct. 1, 1954. Orders for these papers can be accepted only when the *paper number* is stated clearly in the order.

Meetings of Other Societies

Feb. 19–20

National Society of Professional Engineers, spring meeting, Hilton Hotel, Albuquerque, N. Mex.

March 4–5

American Society for Metals, mid-winter meeting, Hotel Statler, Boston, Mass.

March 5–7

Society of Women Engineers, national convention, Mayflower Hotel, Washington, D. C.

March 9–12

American Management Association, general management conference, Fairmount Hotel, San Francisco, Calif.

March 15–19

National Association of Corrosion Engineers, conference and exhibition, Kansas City Municipal Auditorium, Kansas City

March 24–26

American Power Conference, 16th annual meeting, Sherman Hotel, Chicago, Ill.

(*ASME Calendar of Coming Events, see page 207*)

Street in Cuernavaca, Mexico. Church of St. Tepetates in background.

Second Engineering-Management Conference, Philadelphia, Pa., March 31–April 1

Questionnaire Helps Shape Program, Location, Duration, and Dates for Succeeding Divisional Conferences

PLANNING for the second annual Engineering-Management Conference to be held at the Benjamin Franklin Hotel in Philadelphia, Pa., on March 31 and April 1, 1954, under the cosponsorship of the Management Division and the Philadelphia Section of The American Society of Mechanical Engineers, has been greatly facilitated by the results of a unique "market survey." This survey was conducted by means of a questionnaire distributed to those who attended the first Engineering-Management Conference held in Detroit, Mich., in March of 1953. While some of the results of this survey may be particularly pertinent only to the Management Division, it is felt that these results are of considerable interest not only to those who attend division conferences and similar meetings, but also to those who plan and organize such meetings.

Approximately half of those attending the Detroit conference filled out and returned the three-page questionnaire. Of these only 53 per cent were members of ASME, but over 40 per cent of the nonmembers requested membership information.

The importance of a broad publicity program in developing suitable attendance was indicated by the replies to a question on sources of information regarding the conference. The major sources of such information, and the percentages of those who learned of the conference from each source are: Printed conference program, 38 per cent; MECHANICAL ENGINEERING, 28 per cent; Management Division Newsletter, 14 per cent; friends, 12 per cent; the remaining 8 per cent learned of the meeting through various sources including the Detroit section of ASME, the Engineering Society of Detroit, Management Division Executive Committee, and other ASME headquarters personnel, and in several cases from company executives.

Company interest in the conference was indicated by the fact that over 90 per cent of those replying to the questionnaire attended at the expense of their employers. Representatives of the medium-size and larger companies predominated at this meeting; only 19 per cent came from companies of 1000 or fewer employees, while 44 per cent came from companies of 1000 to 10,000 employees and another 37 per cent came from companies of over 10,000 employees. However, almost 41 per cent of the attendees came from companies employing 100 or less engineers.

A number of questions were directed at determining the most favorable location, duration, and dates for succeeding division conferences.

A weighing of first, second, and third choices showed a decidedly heavy vote in favor of Chicago, Ill., with fairly strong enthusiasm for Cleveland, Ohio, and New York, N. Y., but progressively much less enthusiasm for St. Louis, Mo., Kansas City, Mo., and Los Angeles, Calif. Over 38 per cent stated that they could not attend a Los Angeles meeting, and 18 per cent could not attend a meeting in Kansas City. The fact that this survey was taken at a division conference in Detroit can be presumed to have had an important effect on replies regarding future locations for division conferences, but the pattern of cities is of general interest.

The great majority of attendees favored a two-day conference, but a sizeable minority, about one fourth, favored a three-day conference. Monday, Friday, and Saturday, particularly the latter, were felt to be poor conference days, with Tuesday, Wednesday, or Thursday in very good favor. Reaction to the question of the best dates for a second division conference was fairly evenly distributed for the entire proposed period from February 1 to April 15, but with some greater preference for the April 1 and April 15 dates.

While it was not possible to follow all of the apparent majority opinions revealed in the survey, the results of this undertaking have been very helpful in planning the second annual Engineering-Management Conference, particularly in regard to dates, expenses, and most important of all, publicity. The theme of the conference is "Engineering Management in a Dynamic Economy."

The tentative program is as follows:

WEDNESDAY, MARCH 31

Morning Session

Engineering Management and National Policy, by *Arthur S. Flemming*, director, Office of Defense Mobilization, Washington, D. C.

Challenges Facing Engineering Management, by *Hector R. Skifter*, president, Airborne Instruments Laboratories, Mineola, N. Y.

Afternoon Session

Wasted Manpower, by *Trafford W. Bigger*, development engineer, General Electric Co., Schenectady, N. Y.

Selling Your Ideas, by *Phil Carroll*, management consultant, Maplewood, N. J.

Progress Toward a Unity Engineering Organization, by *T. A. Marshall, Jr.*, Engineers Joint Council, New York, N. Y.

Banquet

Speaker: *Lewis K. Sillcox*, ASME President
Subject: To be selected

THURSDAY, APRIL 1

Morning Sessions

Management of Research and Development

Evaluating Competitive Development Programs, by *John J. Grebe*, director, Nuclear Research and Development, and *Alden W. Hanson*, director, Nuclear Research Laboratory, Dow Chemical Co., Midland, Mich.

Planning a Research and Development Program, by *Clifford C. Furnas*, executive vice president and director of laboratory, Cornell Aeronautical Laboratory, Inc., Buffalo, N. Y.

Increasing Creativeness in Engineers, by *William A. Schmall*, Small Appliance Division, General Electric Co., Allentown, Pa.

Management of Sales Engineering

National Consumption and Investment in Capital Equipment, by *Rowe Alderson*, Alderson and Sessions, Philadelphia, Pa.

Managing a Sales-Engineering Department, by *Ralph J. Kraut*, president, Giddings and Lewis Machine Tool Co., Fond du Lac, Wis.

Training Sales Engineers, by *H. G. Ebdon*, vice-president, Combustion Engineering, Inc., New York, N. Y.

Afternoon Session

Executive-Development Programs for Engineers, by *Edward G. Uhl*, vice-president and chief engineer, Glenn L. Martin Co., Baltimore, Md.

Incentives for Engineers, by *James F. Lincoln*, president, Lincoln Electric Co., Cleveland, Ohio

Co-Ordinating Engineering Activities, by *R. B. Read*, director of Planning, Westinghouse Electric Corp., Pittsburgh, Pa.

People . . .

J. Foster Petree, Rice Lecturer and Life Mem. ASME, retired on Dec. 31, 1953, from the editorship of *Engineering*, to which he was appointed on March 1, 1939, jointly with Charles Cooper. Mr. Cooper, who joined the staff of *Engineering* in 1897, relinquished executive editorial direction at the end of 1949, but is still a managing director. Mr. Petree also will continue as a member of the board of directors. His successor as editor will be F. B. Roberts, M.B.E., who has been chief assistant editor since January, 1950.

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P. H. Chase, Philadelphia Electric Company, has been chosen general committee chairman for the Golden Jubilee Meeting of the International Electrotechnical Commission (IEC), to be held in Philadelphia, Pa., Sept. 1–16, 1954. Walker L. Cisler, Fellow ASME, Detroit Edison Company, has been appointed chairman of the Finance Committee for the IEC meeting.

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John Findley Peters, an electrical engineer, who achieved a distinguished career with the Westinghouse Electric Corporation, was awarded the 1953 AIEE Edison Medal at the winter meeting of the institute. He went to work immediately after completing the eighth-grade grammar school near his boyhood home in Chambersburg, Pa. His first job was with the Pittsburgh Steel Company, as an electrician, in 1905. A few months later he joined the Armature Division of Westinghouse and remained with that organization until his retirement in 1950. Mr. Peters is now a Westinghouse consulting engineer. The Edison Medal was awarded to him "for his contributions to the fundamentals of transformer design, his invention of the Klydonograph, his contributions to military computers, and his sympathetic understanding in the training of young engineers."

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Sabin Crocker, Fellow ASME, Ebasco Services, Inc., New York, N. Y., was awarded a certificate of service by the American Standards Association in recognition of his work in the development of American Standards, at a meeting held at the Shelton Hotel, New York, N. Y., Dec. 8, 1953. Mr. Crocker represents The American Society of Mechanical Engineers on the Standards Council, one of ASA's two governing bodies. As vice-chairman he has been especially active on the ASA Committee on Code for Pressure Piping. W. T. McCargo, Carborundum Company, Niagara Falls, N. Y., was also awarded a certificate of service. He served on the Standards Council where he represented the Grinding Wheels Institute.

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Neil E. Hopkins, Mem. ASME, senior engineer, mechanical-engineering department, and J. J. Seelaus, Assoc. Mem. ASME, both of York Corporation, York, Pa., received the Wolverine Award of the American Society of Refrigerating Engineers for the best paper published in the society's journal, *Refrigerating Engineering*, in 1953.

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Ralph F. Baxter, Assoc. Mem. ASME, was awarded the James Walsh Memorial Prize of $1000 by the American Ordnance Association at the annual banquet held on Dec. 2, 1953, at the Waldorf-Astoria Hotel, New York, N. Y. At the banquet, Charles E. Wilson, Secretary of Defense, and Admiral Arthur Radford, Chairman of the Joint Chiefs of Staff, also received awards.

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Leonard S. Hobbs, vice-president for engineering for the United Aircraft Corporation, the man most responsible for development of the Pratt & Whitney J-57 jet engine, was named as the winner of the Collier Trophy for "the outstanding achievement in aviation during 1952." President Eisenhower presented a miniature of the trophy to Mr. Hobbs at the annual Wright memorial dinner held at the Statler Hotel, Washington, D. C., Dec. 17, 1953.

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Chalmer G. Kirkbride, president and director, Houdry Process Corporation, Philadelphia, Pa., has been elected president of the American Institute of Chemical Engineers for 1954, during the 46th AIChE meeting. At the same time, it was announced that the institute had also elected as vice-president, Barnett F. Dodge, professor of chemical engineering and head of the chemical-engineering department at Yale University. George G. Brown, professor of chemical engineering and dean of the University of Michigan, was elected treasurer; and Stephen L. Tyler was re-elected secretary of the institute.

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Carl C. Chambers, dean, Moore School of Electrical Engineering, the University of Pennsylvania, has been elevated to vice-president in charge of engineering affairs. Other promotions announced by the University included the following: Gene D. Gisburne, dean of admissions, as vice-president in charge of student affairs; Arnold K. Henry, dean of student affairs, and Roy F. Nichols, dean of the Graduate School of Arts and Sciences, as vice-provosts. Dr. Nichols, a Pulitzer Prize winning historian, will continue to be dean of the Graduate School.

CHARLES B. ELLEDGE of General Electric Company, Schenectady, N. Y., was elected president of The Material Handling Institute, Inc., for 1954. WALTER E. SCHIRMER, vice-president, Clark Equipment Company, Buchanan, Mich., and EDWARD W. McCAUL, secretary, Jervis B. Webb Company, Detroit, Mich., were elected first and second vice-presidents, respectively.

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JOHN P. O'MEARA and WILLIAM L. ROLLWITZ have been awarded the first annual Judson F. Swearingen Award for outstanding scientific research work at Southwest Research Institute. The recipients, who are members of the institute's physics department staff, were cited for their "pioneer work in nuclear resonance at low magnetic field strengths."

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ROGER ADAMS, professor of chemistry and head of department, University of Illinois, was awarded the 1954 Perkins Medal by the American Section of the Society of Chemical Industry at a dinner meeting held at the Waldorf-Astoria Hotel, New York, N. Y., January 15.

ASME Calendar of Coming Events

March 10–12, 1954
ASME International Meeting, Hotel Del Prado, Mexico, D. F.
(Final date for submitting papers was Nov. 1, 1953)

March 31–April 1, 1954
ASME Management-Engineering Conference, Benjamin Franklin Hotel, Philadelphia, Pa.
(Final date for submitting papers was Nov. 1, 1953)

June 14–17, 1954
ASME Oil and Gas Power Conference, Hotel Muehlebach, Kansas City, Mo.
(Final date for submitting papers was Feb. 1, 1954)

June 14–18, 1954
Second U. S. National Congress of Applied Mechanics, University of Michigan, Ann Arbor, Mich.

June 20–24, 1954
ASME Semi-Annual Meeting, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers was Feb. 1, 1954)

Sept. 8–10, 1954
ASME Fall Meeting, Hotel Schroeder, Milwaukee, Wis.
(Final date for submitting papers—May 1, 1954)

Sept. 13–24, 1954
ASME Instruments and Regulators Division and Instrument Society of America Exhibit and Joint Conference, Commercial Museum and Convention Hall, Philadelphia, Pa.
(Final date for submitting papers—May 1, 1954)

Sept. 26–29, 1954
ASME Petroleum-Mechanical Engineering Conference, Statler Hotel, Los Angeles, Calif.
(Final date for submitting papers—May 1, 1954)

Oct. 28–29, 1954
ASME-AIME Joint Fuels Conference, William Penn Hotel, Pittsburgh, Pa.
(Final date for submitting papers—June 1, 1954)

Nov. 28–Dec. 3, 1954
ASME Annual Meeting, Statler Hotel, New York, N. Y.
(Final date for submitting papers—July 1, 1954)
(For Meetings of Other Societies, see page 205)

NRL chemists cited for machine-gun lubricant system. Five members of the Surface Chemistry Branch of the Naval Research Laboratory have been commended for their work in the development of an all-weather lubricant system for automatic aircraft cannon. In addition to being used in the Korean War, this system is covered by a Navy specification—MIL-L-17353 (Ord)—and is being used as a basis for a proposed Department of Defense specification. *Left to right:* Parry Borgstrom, superintendent, Chemistry Division; W. A. Zisman, head, and Charles M. Murphy, Surface Chemistry Branch; Captain W. H. Beltz, director, Naval Research Laboratory; Jacques O'Rear, Paul B. Leach, and Vincent G. Fitzsimmons, Surface Chemistry Branch.

Spending for Industrial Research

THE Division of Research, Graduate School of Business Administration, Harvard University, recently published a bulletin entitled, "Spending for Industrial Research, 1951 and 1952." The authors, D. C. Dearborn, R. W. Kneznek, and R. N. Anthony, with an advisory committee of eight authorities in the field, participated in the preparation of the final report.

The bulletin reports on the results of three co-ordinated surveys of spending for research and development by industrial companies in 1951 and 1952. The impetus for these studies came from the Research and Development Board of the Department of Defense (now the Office of the Assistant Secretary of Defense for Research and Development), the Office of Naval Research, the Industrial Research Institute, Inc., and the Committee on Research of the National Association of Manufacturers.

These groups had long been interested in obtaining quantitative information on the amounts spent for industrial research, and in 1951 each of them was considering the possibility of conducting separate surveys to obtain such information.

The Division of Research of the Harvard Business School was asked to undertake two of these surveys: one of a large cross section of industrial companies, and the other of a selected group of companies known to have relatively large research organizations. The third survey was directed at *all* industrial companies believed to do research, and was conducted by the U. S. Bureau of Labor Statistics and the Research and Development Board. Many of the questions asked on the latter survey did not relate directly to the topic of industrial-research spending, but some questions on this topic were included.

The bulletin, which reports on the two surveys conducted by the Harvard Business School, contains the introduction and summary of the findings, a report on the 4800-company survey, 1450-company survey, and 191-company survey, in addition to tables, questionnaires, and charts.

A copy of this extremely informative 103-page bulletin may be purchased for $2.50 a copy.

ASME Membership as of Dec. 31, 1953

Honorary Members	52
Fellows	383
Members	14,016
Affiliates	334
Associate Members (33 and over)	3,343
Associate Members (30–32)	1,985
Associate Members (to the age of 29)	18,987
Total	39,100

ASME Elects Seven Fellows

THE American Society of Mechanical Engineers has honored seven of its members by electing them to the grade of Fellow of the Society.

To be qualified as a nominee to the grade of Fellow one must be an engineer with acknowledged engineering attainment, 25 years of active practice in the profession of engineering or teaching of engineering in a school of accepted standing, and a member of the Society for 13 years. Promotion to the grade of Fellow is made only on nomination by five Fellows or members of the Society to the Council, to be approved by Council.

The men whose outstanding contributions to their profession and to the Society were so honored are:

Earle Buckingham

EARLE BUCKINGHAM, professor of mechanical engineering, Massachusetts Institute of Technology, Cambridge, Mass., is widely known as an authority on machine manufacture, measurements, and gears, and for his articles and books on gear design. In 1945 Professor Buckingham was awarded the Worcester Reed Warner Medal for his original contributions to engineering literature in the fields of interchangeable manufacturing and gearing. His group of books on gear design, production, and application are considered outstanding in this field of mechanical engineering. In 1950 he was honored with the Edward P. Connell Award of the American Gear Manufacturers Association for his work as an author and a teacher in this field. Professor Buckingham joined Massachusetts Institute of Technology in 1925 as an associate professor. Prior to this time he was employed by a number of large industrial organizations. He has contributed to the design and development of a variety of equipment. His work on gears has extended to those for all purposes and sizes from about 0.041-in. diameter to 40-ft diameter. Professor Buckingham has had more than 50 papers and articles published. He is the author of six books: "Principles of Interchangeable Manufacturing," 1921; "Involute Spur Gears," 1921; "Spur Gears," 1928; "Dynamic Loads on Gear Teeth," 1931; "Manual of Gear Design," 1937; and "Production Engineering," 1942. He has done much work in the field of standardization and has served for many years on various standards committees of the ASME.

Karl T. Compton

KARL T. COMPTON is chairman of the Corporation of the Massachusetts Institute of Technology, Cambridge, Mass. He has made outstanding contributions in science, engineering education, and public service. Dr. Compton spent 15 years on the faculty of Princeton University, Princeton, N. J., becoming chairman of the department of physics in 1929. In 1930 he was appointed president of M.I.T. and served in this office until 1948 when he became chairman of the Corporation. Among the many important contributions he has made to this institution is the reorganization of its academic administration into schools of science, engineering, architecture, and industrial cooperation. During his presidency the Eastman laboratories of physics and chemistry and the Wright Brothers wind tunnel were built. Also a laboratory for gas-turbine research, a building for the school of architecture, a servomechanisms laboratory, the Sloan Automotive Laboratory, the Van de Graaff High-Voltage Generator Laboratory, the chemical-engineering laboratory, and a cyclotron were established. Perhaps his most important public service is in connection with the atomic bomb. In 1945 he was a member of the Secretary of War's Special Advisory Committee on the Atomic Bomb; in 1946 a member of the President's Personal Committee on the Atomic Bomb Test, and the Joint Chief of Staff's Evaluation Board on Atomic Bomb Tests. His other top government posts include: Chairman, Radar Committee of the Joint Committee on New Weapons of the Joint Chiefs of Staff, 1942–1945; chairman, U. S. Radar Mission to the United Kingdom, 1943; director, Pacific Branch, Office of Scientific Research and Development, 1945; and chairman, President's Commission on Universal Military Training. He has been a member of the following: National Defense Research Committee, OSRD, 1940–1947; Advisory Board, Chemical Warfare Service, 1945; Scientific Intelligence Mission to Japan, 1945; and chairman of the Research and Development Board of the Department of Defense. He has been the recipient of many honors including the Rumford Medal in 1931; the Medal of Merit, highest civilian award in 1946; the Marcellus Hartley Medal, National Academy of Science, 1947; the Washington Award, Western Society of Engineers, 1947; the Lamme Medal, ASEE, 1949; the Procter Prize for scientific achievement, Scientific Research Society of America, 1950; and the Hoover Medal, 1950. He is a past-president of the American Physical Society, the American Association for the Advancement of Science, and the American Society for Engineering Education. He is the author of approximately 100 technical publications.

Jacob P. Den Hartog

JACOB P. DEN HARTOG, professor of mechanical engineering, in charge of the Applied Mechanics Division, Massachusetts Institute of Technology, Cambridge, Mass., has been closely associated with the development of the science of mechanical vibrations. In 1924 he became interested in this subject during his early career at Westinghouse Research Laboratories, Pittsburgh, Pa., so much so that he studied hydrodynamics and aerodynamics under Prandtl, at the University of Göttingen, 1930–1931. This interest continued during his later career at Harvard University from 1932 to 1941. Harvard University conferred an honorary MA degree on him in 1942. Many aspects of mechanical vibration that are now common were first studied by Professor Den Hartog. His papers in ASME Transactions and other technical publications are considered basic to many of the later works in this field. Among his early works are analyses of tuned dampers, nonlinear systems, friction damping, and many other subjects. His book on "Mechanical Vibrations" is widely used as a textbook and reference book. During World War II he was associated with the vibration work carried on by the Bureau of Ships of the Navy Department. He participated in trials of every new class of ship and of practically every new capital ship constructed by the Navy during World War II, making valuable contributions to the control of vibration on these vessels. After the war he was a member of the Naval Technical Mission to Europe. He was the recipient of the Richards Memorial Award, 1947, and the Worcester Reed Warner Medal, 1951. In 1938 he was coeditor of the transactions of the Fifth International Congress of Applied Mechanics. His books include: "Mechanical Vibrations," 1934, 1941, and 1946; "Mechanics," 1948; and "Strength of Materials," 1949. He has contributed to "Mark's Mechanical Engineers' Handbook." He is a past-chairman of the ASME Applied Mechanics Division.

Charles Stark Draper

CHARLES S. DRAPER, director, instrumentation laboratory, and head, department of aeronautical engineering, Massachusetts Institute of Technology, Cambridge, Mass., has made many important contributions to national defense in the field of instrumentation, servo-controlled gunnery, and advanced automatic navigation equipment. Professor Draper's ideas on computing gun sights were well developed just before World War II. With the support of the Sperry Company and the U. S. Navy, these ideas were further developed and led to the Mark 14 sight, which literally stopped the extremely serious Kamikaze warfare in the Pacific. His contributions were recognized by the Navy in the form of a substantial grant to M.I.T. used for research. At the present time Professor Draper operates a research and educational laboratory and is working on navigational and fire-control equipment. In 1946 Professor Draper received the Medal for Merit, highest civilian award; the Naval Ordnance Development Award for work in the field of antiaircraft-fire control; and the Sylvanus Albert Reed Award of the Institute of the Aeronautical Sciences for "application of the gyroscope to computing devices for gunnery and to other computing devices." In 1951 the U. S. Air Force presented him with its highest civilian decoration, the Exceptional Civilian Service Award, in recognition of his outstanding contribution in solving Air Force technological problems during and since World War II. The same year the ASME Industrial Instrument and Regulators Division presented Dr. Draper with a testimonial of appreciation. Professor Draper has written numerous articles in the fields of instrumentation and control. He holds several patents relating to measuring and control equipment.

Ben George Elliott

BEN G. ELLIOTT, chairman, department of mechanical engineering, University of Wis-

consin, Madison, Wis., has made many contributions to engineering in the role of an educator of future engineers. He began his teaching career as an instructor in mechanical engineering in the University of Wisconsin's Extension Division in 1913. From 1915 to 1917 he was associate professor of mechanical engineering at the University of Nebraska. In 1917 he rejoined the staff of the University of Wisconsin's Extension Division. Since 1919 he has been professor of mechanical engineering and since 1947 has served as chairman of the mechanical-engineering department in the college of engineering. During 1918 and 1919 he was a district representative of the Great Lakes District, Section on Education and Training, Emergency Fleet Corporation, U. S. Shipping Board. Professor Elliott has spent much time and energy in selling the engineering profession to youth. His activities in this direction include serving as chairman, Student Branch Committee, Region VI, for three years, and as faculty chairman of the University of Wisconsin's Student Branch many times. He was a member of a committee to study operation of student branches in the United States. Professor Elliott has been active in ASME affairs. He is a past-chairman of the ASME Rock River Valley Section. At present he is Vice-President of ASME Region VI. Professor Elliott is the author of three textbooks, "The Automobile Chassis," "Automobile Power Plants," and "Automobile Repairing," and coauthor of "The Gasoline Automobile." He has written many magazine and newspaper articles.

Frank M. Gunby

Frank M. Gunby, Charles T. Main, Inc., Boston, Mass., has been associated with this company since 1905, except for military service during World War I. He was in charge in 1908 of design and supervision of construction for the office of power work for the Pacific Mills. This consisted of one of the earliest electrifications of a large textile mill which depended on a distantly located power plant with steam turbines, electric transmission interconnection of redeveloped hydroelectric plants, and motor and lighting work. He did much of the original engineering for one of the early vertically organized systems of cotton textiles running from production of cloth to their finishing, and so on, including power plants and some of the earliest systems of ranging machines for continuous operation. Mr. Gunby has had charge of design and supervision for mills, power plants, and sugar-refining plants for many industries around the country and in India, Argentina, Canada, and Mexico. During World War I he was in charge of engineering of the Construction Division of the Army which was responsible for all war construction in continental U. S. During World War II he handled for his firm the architect-engineer work in several large camps, ordnance, and chemical-warfare plants. This work included the largest RDX explosive plant. During the depression of the 1930's he spent a great deal of time on the organization by the engineers and architects around Boston to relieve distress in their groups. An outstanding job was done. Mr. Gunby is the author of several papers. He takes an active interest in Society affairs, having served on the Nominating and Medals Committees, as Vice-President, Region I, and as a member of the Special Committee on Society Policy.

Bryan Towne McMinn

Bryan T. McMinn, executive officer, department of mechanical engineering, University of Washington, Seattle, Wash., has been active in the fields of mechanical engineering and engineering education in the Northwest for many years. He joined the University of Washington as an instructor of mechanical engineering in 1920. In 1931 he became associate professor of mechanical engineering and, in 1939, professor of mechanical engineering with full charge of courses in materials of engineering, machine design, and mechanisms. He became executive officer of the department in 1946. It is believed that Professors McMinn and Edmonds at the University of Washington shared the distinction with the Union College of Schenectady of introducing the photoelasticity technique to engineering in this country, which they began studying in 1923. Professor McMinn has developed and constructed many models and teaching aids which are still in wide use. Under Dean E. A. Loew, in 1940–1943, he was in active charge of wartime emergency training programs for engineers and technicians at the University. Professor McMinn is an authority on hand-harness and Jacquard looms, with particular reference to operation by the blind. He has designed and constructed many machines and instruments including universal hydraulic testing machines, woodworking machinery, weaving looms, and strain-measuring instruments. He has acted as special consultant to many business firms. Professor McMinn has contributed many papers to technical and educational journals. He has been active in Society affairs, serving as chairman, Western Washington Section in 1938, 1939, and 1944.

J. J. Jaklitsch, Jr., Associate Editor of "Mechanical Engineering"

J. J. Jaklitsch, Jr., who has been employed for the past eight years in the editorial department of The American Society of Mechanical Engineers, has been named Associate Editor of Mechanical Engineering. He is also an associate editor of *Applied Mechanics Reviews*, a journal of abstracts published monthly by ASME.

He was a contributing editor to "The American Year Book," published by Thomas Nelson and Sons. Currently he is a contributing editor to "Collier's Year Book," published by P. F. Collier & Sons.

Prior to joining the ASME editorial staff, Mr. Jaklitsch was employed by the U. S. Army Ordnance Department, where he was engaged in both an engineering and editorial capacity on U. S. Army instruments ranging from simple "Bazooka" sights, telescopes, and telescopic mounts for guns and howitzers, and tank periscopes, to such complex electromechanical computing devices as are used for pointing and firing antiaircraft guns, gun-data computers, and other remote-control computing instruments.

A New Yorker by birth, Mr. Jaklitsch received a bachelor's degree in mechanical engineering from Pratt Institute, in Brooklyn, N. Y. in 1940.

He joined the Society as a Junior Member in 1941 and was promoted to Member of the Society in 1950.

EMC and SMC Announce Plans for 1954

In accepting the chairmanship of the Engineering Manpower Commission of Engineers Joint Council for another year, T. H. Chilton, Mem. ASME, technical director, engineering department, E. I. du Pont de Nemours & Company, Inc., Wilmington, Del., announced that EMC and the Scientific Manpower Commission will work in close co-operation during 1954 in their approach to the common problems of engineering and scientific manpower.

In 1950 Korea set off a chain of events that focused the attention of scientific and engineering organizations on manpower problems, none of which had been satisfactorily solved in World War II. EMC was established in response to a request from the Manpower Office of the National Security Resources Board in September, 1950, to prepare a program "for the most effective utilization of engineers in the national effort and make recommendations as to how such a program could be best administered." Recommendations were made with respect to the importance of engineering to the national economy, the critical shortage of engineers and enginering students, the Selective Service, Universal Military Service, extended ROTC proposals, and the registration of engineers.

To meet a similar need in the field of scientific manpower the American Association for the Advancement of Science, American Chemical Society, American Geological Institute, American Institute of Biological Sciences, American Institute of Physics, American Psychological Association, Federation of American Societies for Experimental Biology, and Policy Committee for Mathematics established the Scientific Manpower Commission in March, 1953.

Concurrent with the announcement that Dr. Chilton would continue as chairman of EMC for 1954, other officers were named. M. M. Boring, Mem. ASME, manager of Technical Personnel Division, General Electric Company, Schenectady, N. Y., was designated as vice-chairman, and T. A. Marshall, Jr., Mem. ASME, will continue as executive secretary.

The Scientific Manpower Commission also announced its recently elected officers, among whom are included: M. T. Carpenter, administrative director, Standard Oil Company of Indiana, president; Howard A. Meyerhoff, executive director; John S. Nichols, Yale University, vice-president; and Dael Wolfle, National Research Council, secretary-treasurer.

In commenting on the EMC and SMC Programs for 1954, Dr. Chilton stated, "The problems of engineering and scientific man-

power in our country, as in many other countries, are grave and complex and the activities of EMC and SMC have correspondingly many facets. A primary aim of both organizations, however, will be to function as catalyzers and to carry on and co-ordinate activities to the end that the recruitment, training, and utilization of scientists and engineers will be seen as an integrated sequence of responsibilities with which the professional societies, industry, education, government, and the public are all vitally concerned.

Mid-Century Conference on Resources for the Future

THE Mid-Century Conference on Resources for the Future completed on Dec. 4, 1953, its three-day examination of the natural-resources position of the United States and the probable developments to be anticipated during the next quarter century.

Former Ambassador Lewis W. Douglas, chairman of the board, Mutual Life Insurance Company of New York, and chairman of the Conference, said that the Conference had identified domains of agreement and areas of disagreement in the approach to natural-resource problems, and that the exchange of views by a wide assortment of individuals of a great variety of skills and talents had clarified the reasons for disagreement in this field.

The Conference, in which 1472 industrialists, labor officials, businessmen, social and physical scientists, conservationists, officials of local, state, and federal governments, and foreign observers participated, was financed by a grant from The Ford Foundation.

It was initiated by Resources for the Future, Inc., a nonprofit corporation devoted to research and education in the field of resources development and conservation.

The three-day Conference reached no conclusions—there were no resolutions—and no votes. It was planned as a citizens' conference for free discussion of issues, and for the compilation of facts and opinions on which public and private agencies and groups might chart their plans and policies.

Almost all of the work of the Conference was done in eight Sections, meeting concurrently on various aspects of the resources problem. There were 118 participants in Section 1 (Competing Demands for Use of Land), 254 in Section 2 (Utilization and Development of Land Resources), 232 in Section 3 (Water-Resource Problems), 106 in Section 4 (Domestic Problems of Nonfuel Minerals), 170 in Section 5 (Energy-Resource Problems), 157 in Section 6 (U. S. Concern With World Resources), 126 in Section 7 (Problems in Resource Research) and 125 in Section 8 (Patterns of Co-Operation), plus 184 who attended various meetings, but registered for no particular group.

The opening session was a general meeting of the entire Conference, for a panel discussion of a paper, *A Mid-Century Look at Resources*, prepared by The Brookings Institution as a basic approach to the general and specific problems. President Eisenhower greeted the participants at a luncheon on Wednesday, December 2, expressing his profound interest in conservation, which he defined as *use* without waste.

There were panel discussions also at two general dinner meetings, December 2 and 3, on control of public lands and world resources. The final session also was a general meeting, at which summary reports were presented on the work of the eight Sections.

The Conference was the first major project of Resources for the Future, Inc., and Dr. Reuben G. Gustavson, president and executive director of the organization, indicated that its directors are now studying a number of proposed projects for future action.

"...It shall be a part of Resources for the Future to make the most careful kind of studies," Dr. Gustavson told a luncheon meeting, "in order that we may make good judgments as to where this organization may place its funds in order to obtain the best return from the long-range point of view.

"We are looking forward to the use of ad hoc committees of people who are experts in the field to advise us on the various projects which are presented and which we may develop ourselves, in order to choose those which limited funds should support. We are thinking not only of this grant program, but we feel that one of our projects, and a fundamental one, should be to perhaps periodically publish essays calling to the attention of our people progress that has been made in certain resource fields which is altering the picture before us. We should have a significant staff, perhaps, which should carry out basic studies so that periodically we can publish a volume which will tell the American people the position that we occupy with respect to our resources and with respect to the resources of the world.

"If we do this, we hope it will be so competently done, that 25 years from now people may look back on this organization and have the feeling that what the Rockefeller Foundation, for example, was able to do for the health of society in terms of biological health, perhaps we in some way have approached in terms of competence for the social and economic health of our people."

ASM Awards High-School Students and Teachers for the Third Year

FOR the third straight year, the American Society for Metals is awarding cash and United States Bonds to high-school science students all over the United States.

According to W. H. Eisenman, Secretary of ASM, a total of 50,000 high schools and high-school teachers have been invited to participate in this, the Third Annual Science Achievement Award Program sponsored by ASM and conducted by the National Science Teachers Association for the Future Scientists of America.

Last year's results are themselves impressive. Ninty-one students received cash and bonds; 133 were given honorable mention awards.

All high schools having place award winners were given bronze plaques in the names of student winners.

The program also included recognition awards for science teachers. Eighteen high-school teachers entered reports on outstandingly successful techniques and practices for teaching science and were each given $50 in cash prizes.

"We believe that the Science Achievement Awards Program for high-school students and high-school teachers will greatly stimulate interest in the advantages of engineering as a career, with good results for industry and the nation," Mr. Eisenman said.

Women Have Opportunity to Invade Engineering Profession

WOMEN have the "opportunity of a lifetime" to invade the engineering profession, according to Lois McDowell, assistant professor of mechanical engineering at Illinois Institute of Technology, Chicago, Ill.

She said there is a serious shortage of engineers and a growing emphasis on "brain" work and less physical labor.

Industry, she said, urgently needs engineers—women as well as men. The need for engineers has been estimated at more than 30,000 a year, "and there is little hope that this figure will be met," she added.

Mrs. McDowell also pointed out that 75 per cent of all engineers are in administration, management, design, research, and development, leaving only 25 per cent in manufacturing, production, construction, or the operating side.

With emphasis being placed more on the brain work, she said, "Certainly, the well-trained woman has no handicap in this respect."

Mrs. McDowell, who was the first woman to receive a master's degree in mechanical engineering at Illinois Tech, also cited the establishment of the Society of Women Engineers in 1952 as a milestone in the progress of women in her field.

She advised high-school girls to examine their aptitudes, abilities, and preferences to help themselves in determining whether they would be successful in engineering.

"Ability in mathematics is a prime requisite in engineering," she said. Also important are ability to visualize and preference for mathematics, science, and such subjects as mechanics, electricity, and chemistry.

Mrs. McDowell first studied at Rensselaer Polytechnic Institute, Troy, N. Y., and was one of the first four women to be accepted by that school.

Junior Forum . . .

Conducted by Joseph Schmerler, Assoc. Mem. ASME

How to Attract and Hold Engineering Talent

A REPORT on "How to Attract and Hold Engineering Talent" has just been issued by the Professional Engineers Conference Board for Industry as the result of a survey in which 200 industrial employers of engineers and 1400 engineers employed in industry participated. The survey is basically designed to provide management with a blueprint on how to create a climate in which engineers can work happily and effectively in an employee capacity.

Among the attitudes of employment surveyed, of both employee and employer, were (1) salary considerations, (2) campus recruiting techniques and results, (3) differentiation in personnel policies between engineers and nonprofessional employees, (4) encouragement by management of engineer participation in professional-development activities, (5) improvement of engineer-management communication, and (6) assignment of engineers to engineering duties.

Since all these topics are intimately connected with the problem of adequate employee-employer relationship, and especially of major concern to beginning engineers, Junior Forum is abstracting parts of the survey report in order to show both sides of the picture on any particular point in question.

When one starts to think about the problems involved in such a discussion, it seems best to begin through an investigation of what goals the young engineer has set for himself. The report points out that although adventurous engineers still are building radio stations high in the Andes, air fields in Africa, and submarine bases in the far north, the average young engineer of 1954 is not looking for glamour in far-off places but for security, both immediate and for the years to come. He wants not only adequate compensation but also professional recognition and a sense of personal accomplishment.

Depression Psychology Remains

Although he was still a small boy when the great depression of the thirties ended, the young graduate of today still remembers its dislocations and its effects, and he wants a safe berth for himself in industry.

This is brought out clearly in his answers to the survey questionnaire where he indicated that financial reward represented only 13 per cent of his reasons for entering the engineering profession.

After he has been in industry for a time, though, his attitudes change, as shown by the question, "Are you satisfied with your present job?" so that 45 per cent of his thinking on this subject involves salary consideration.

Something for Nothing

Many of the executives questioned feel that the engineer's preoccupation with money was a manifestation of a "something for nothing" attitude—that he was more interested in what he was going to get out of industry than in what he was going to put into it.

"Young engineers must be made to realize that their engineering understanding must be converted to productive output," said the superintendent of engineering personnel of a large western aircraft-manufacturing concern. "Too many of them feel that they can understand a bigger job, but overlook the fact that their output on their present job is far from satisfactory."

Said G. E. Shubrooks, manager of research of the Hamilton Watch Company, Lancaster, Pa.: "The free flow of Government money has completely upset the engineering profession from the standpoint of the engineers being able to get high pay for little effort."

The same feeling was echoed by a number of others among the executives questioned. But the replies of both employee and employer to the questionnaires, when checked against each other, indicated that perhaps management itself is partly to blame for this attitude, if such an attitude actually exists on a widespread scale.

Both the executives and the engineers were asked if the engineering personnel were kept currently informed of their personal progress within the company.

Difference of Opinion

Eighty-five per cent of the executives answered in the affirmative—but 50 per cent of the engineers said "no."

It is possible that both were right, since many times more engineers than executives were surveyed, and the latter were handpicked from among companies known to have progressive and successful personnel

First Private Reactor: Engineering students at North Carolina State College check operation of the college's nuclear reactor, the first constructed exclusively for peacetime atom development and the first to be privately owned. In the background is a bank of electronic recording and controlling instruments specially developed by Minneapolis-Honeywell to regulate key aspects of the $120,000 low-power reactor. The reactor, part of a $620,000 facility, will primarily be used as part of the college's nuclear-engineering curriculum. Among the reactor's uses will be to accumulate data which may spur atomic-power development as well as broadening radiation research into the areas of physics, chemistry, biology, medicine, and agriculture. The one kilogram of U-235 to run the reactor is loaned by the AEC. At full output the reactor generates only 10 kilowatts of heat energy but supplies more atomic radiation than $200 million worth of radium.

policies, whereas the large sampling of engineers was not but was intended rather to represent a fair cross section of American engineering activity—good and bad.

It is plain, however, that more than half of that large group of engineers do not know whether their employers are satisfied with their work or not. And they would like to know.

It would appear that in the great industrial expansion of the past few years, in the rush to turn out the tremendous volume of materials and manufactured goods demanded by the military, perhaps industry *has not* given enough thought to supervision and guidance, and perhaps, because of the shortage of professional talent, the tendency has been to move young engineers up to positions of responsibility before they were ready for it.

Reversal of Form

Some support is lent to the latter speculation by the engineers' answer to the question: "Do you think you are subjected to too much supervision?"

It is the nature of youth to be rebellious and resentful of authority, and the answer might be expected to have been weighted toward the affirmative side, at least among the junior engineers. Such, however, was not the case. Eighty-six per cent of those questioned answered "no."

One way of keeping the engineer informed of his personal progress is the merit-rating system, a device which at present is employed by only half of the companies surveyed.

Seventy-eight per cent of the engineers—including a large proportion of the discontented group and the group which feels that industry is not making effective use of their training and talents—said they would like to have their work evaluated by a merit-rating system.

It would seem, therefore, that those employers who do not have some system of keeping the members of their engineering staffs informed of personal progress might give thought to the possibility of installing a merit-rating system or some similar device.

Training Opportunities

One of the best devices not only for recruiting new engineers but also for retaining their services is the maintenance of an adequate training program, coupled with a policy of upgrading professional personnel from within.

Training programs are not new in American industry. Nearly all companies, except the very smallest, have some organized system of orienting their new employees and of training them in specific applications of the scientific background they have gained in college.

Never, however, has there been such a tremendous expansion of such programs as has taken place since the beginning of World War II, and in many of the larger plants the training courses actually are continuations of the formal college curriculums. Credits toward advanced academic degrees are granted for completion of a few of these courses.

There also has been a growing tendency in industry to assist the abler young engineering personnel financially in their pursuit of graduate university work, a device which, those who have tried it say, works both to the benefit of the company and the engineer and is a major factor in the retention of the services of brilliant young men who might otherwise be lured away to greener financial pastures.

A Stake in the Firm

Another effective method of promoting continuity of service—one which long has been used by the larger corporations and which is now being inaugurated on an increasingly widespread scale by smaller firms—is the profit-sharing or stock-bonus plan.

One of the most interesting is the stock-purchase plan used by the Sun Oil Company of Philadelphia and Marcus Hook, Pa. There, all employees are permitted each year to buy stock in the company to an amount equivalent to ten per cent of their annual pay at the average price per share prevailing over the previous quarter.

The company then adds, in stock, 50 per cent of the employee's purchase, so that he actually obtains the securities for two thirds of their real value.

The significant provision in the plan is that although dividends start at once and are payable to the employee as soon as they are declared, the actual transfer of title to the stock certificates does not take place until one year after the purchase has been accomplished. If the employee leaves the company during the year, he is refunded the amount he paid in, but his shares, along with the company's 50 per cent stock contribution, go into a stock pool which is divided at the end of the year among the other employee stockholders, on a pro-rata basis, as a bonus.

Conclusions

Security and an opportunity for advancement are the primary objects of the engineer today, with professional recognition and a sense of personal achievement running close behind.

Although present salary scales are at the highest level in history, he still is not quite satisfied with his current rates of pay, nor does he feel that his ability is being utilized fully.

That there is a stoppage in the channels of downward communication between management and engineers is indicated by the fact that more than half of those surveyed do not know whether their employers are satisfied with their work or not, or how they stand in relation to their fellow engineers. Further work on the improvement of communications seems indicated, and the possibilities of a merit rating system should be explored.

Among other effective devices for increasing the engineer-employee's sense of security are pension and stock-bonus plans and opportunities for continuation of professional training.

ASME Council Actions on 1953 National Agenda Reported

How the National Agenda is Compiled for Regional Administrative Committees and Items Which Are Ultimately Acted On by Regional Delegates Conference.

The American Society of Mechanical Engineers has developed a procedure whereby action is taken by all Sections on suggestions made by any Section to improve policies, procedures, and operations of the Society. This procedure starts with the compilation by the National Agenda Committee of preliminary statements of the items suggested. If 15 Sections approve any one item, it is included in a National Agenda for discussion at Regional Administrative Committee meetings held in the spring. Further discussion at a national level takes place at the Regional Delegates Conference held during the Semi-Annual Meeting. The results of this Conference are then submitted to the Council.

The principal business of the Regional Delegates Conference held during the Semi-Annual Meeting is to consolidate the actions of the eight RAC meetings on the National Agenda and to report the consolidated view to the Council. Related matters frequently arise on which a consolidated view is developed or on occasion the Council may request the opinion of the RDC on a Society policy or procedure. The Council is usually in session at the same time as the RDC and provision is made for the Delegates to attend the Council Meeting.

A report of the principal actions of the Conference is made to Council for information at the Council Meeting during the current Semi-Annual Meeting. The Council studies the full set of final minutes when prepared, referring to the various administrative agencies of the Society the different items with which those agencies are concerned.

The actions of Council on the Recommendations of the RDC are reported to the Delegates and to the Section Executive Committees before the next RAC meetings. Thus the cycle from origination of items by the Sections to action by Council is completed within one year.

Compilation of the National Agenda

About September 15th of each year the chair-

man of the Agenda Committee sends forms to the Sections and requests the submission of items by October 31.

Upon receipt of the items, the Agenda Committee reviews them, corresponds with the suggesting Section, and refers the items that can be dealt with promptly, as administrative matters, to the proper administrative agency.

About January 1, a compilation of all items passed by the committee is sent to the Sections for an expression of opinion as to inclusion in the final agenda. By the end of February the Agenda chairman must have all the opinions. Fifteen Sections must approve an item before it can become a part of the National Agenda, which is sent out to all the Sections at least three weeks in advance of the first RAC meeting.

Action in the Sections

The National Agenda requires action in the Section Executive Committee on at least three points.

A In the original suggestion of items. In this process it is desirable to canvass member opinion by some method, by mail, or at a Section Meeting.

B The expression of opinion about including an item in the National Agenda.

C A determination of the position the Section is to take on the items in the National Agenda.

It is generally desirable for the Section to select its representatives to the RAC meeting at an early date so that they may be in touch with the entire process of developing the National Agenda.

A summary of actions by the Council on recommendations of the 1953 regional delegates conference (Los Angeles) follows:

Final Report

Agenda Topic No. 2: One National Meeting, preferably the Annual Meeting, includes a symposium each year on Section Operations, with papers to be contributed largely by Sections.

Delegates' Action: CARRIED 8 to 7

Council Action: This item was considered by the vice-presidents at Los Angeles in June, 1953, and held for final action at New York in November, 1953.

The suggestion was disapproved for the following reasons:

1 The RAC meetings are the more suitable place to discuss Section Operations as each Section is represented officially, there is time for such discussion, and, in fact, the most important purpose of RAC meetings should be the discussion of ways and means of improving Section Operations.

2 The Annual Meeting is overcrowded now and the schedule of responsible officers during the Meeting is too full to permit them to devote necessary time to such a session.

3 The vice-presidents are planning extended discussions of Section Operations at the 1954 RAC meetings.

The Council voted to disapprove the item.

Agenda Topic No. 9: The vice-president of a Region should be responsible for the follow-up on an agenda item that (*a*) originates in his Region and (*b*) is acted upon favorably by the Regional Delegates Conference.

Delegates' Action: CARRIED 9 to 5

Council Action: The vice-presidents interpreted "follow-up" as meaning one of two things (1) special attention by a vice-president at the Council meeting to agenda items arising in his Region or (2) a special report to the Region by the vice-president about Council action on an agenda item arising in his Region. Agenda items that have passed through the RAC and RDC process are of Society significance rather than Regional or local. In fact, in the minutes of the RDC mention of the originating Section is omitted. Equal consideration is given to all items by the Council members. All Council actions are reported to the Regions and the Sections. The vice-presidents expressed the view that whichever of the two interpretations was made, they required no special admonition other than their general duty of serving the Society to the best of their ability.

The Council voted to disapprove this item.

Agenda Topic No. 10: All the agenda items submitted to Council by the Regional Delegates Conference be given publicity in MECHANICAL ENGINEERING. It is further proposed that the action of Council on all these items be reported in MECHANICAL ENGINEERING.

Delegates' Action: CARRIED UNANIMOUSLY

Council Action: With the approval of the Publications Committee, the Council voted to request the Editor to report in MECHANICAL ENGINEERING the agenda items approved by the Regional Delegates Conference and submitted to the Council with the action of the Council on these items.

Agenda Topic No. 15: Members of the Regular Nominating Committee be elected for a term of two years, four to be nominated each year on alternate years to the nomination of the vice-presidents in the respective Regions. No member to serve more than one term of two years consecutively.

Delegates' Action: CARRIED 9 to 6

Council Action: The 1953 and the 1954 Nominating Committees concur in this recommendation although there was strong minority opposition. The purpose of the recommendation is to give the members of the Nominating Committee better experience which they believe necessary and to provide continuity in the Committee. The opposition points out that continuity can be had by advice from the chairman for the preceding year and strongly states that a continuous nominating mechanism may lead to abuses.

The Council voted (1) to refer the recommendation to the Constitution and By-Laws Committee to prepare By-Law revisions to consider at the next Council meeting, (2) to direct the attention of Regions I, III, V, and VII to the fact that the recommendation may be followed under the present By-Laws and suggest they follow the new procedure to determine any difficulties that develop before making the procedure compulsory.

Agenda Topic No. 24: The study of a professional-engineer unity group having jurisdiction over all engineering should be continued and intensified. Interim reports and discussion should be published in the magazine.

Delegates' Action: This item was tabled pending a report to the RDC about EJC activities by E. J. Kates. Later removed from the table, the item was approved unanimously.

Council Action: See Item 31A.

Agenda Topic No. 35: It is proposed that the (National) Secretary's office send to each graduated Student Member by first-class mail a letter containing literature, data, and inducements to transfer to Associate Member. This should be mailed to last-known address not later than September 1.

Delegates' Action: CARRIED 11 to 4

Council Action: The Council voted to authorize the suggested mailing in the summer of 1954 as an experiment and to request the Secretary to report back for consideration of the matter when the results are known.

Agenda Topic No. 31A: It is proposed in connection with the question of the EJC Exploratory Group Committee on the Unity of the Engineering Profession,

1 That at the Regional Delegates Conference a complete report be made as to progress by one of the Society's representatives to EJC.

2 That Sections at the RAC meetings fully discuss the matter and the delegates to the Regional Delegates Conference be prepared to submit their Region's views on the matter.

Delegates' Action: CARRIED UNANIMOUSLY

Council Action: In 1951 the RAC meetings devoted a great deal of time to the discussion of four plans for developing unity in the engineering profession submitted by the Exploratory Group representing 15 Societies. The 1951 RDC summarized this discussion in a carefully prepared proposal to the Council, as follows:

BE IT RESOLVED: That it is the consensus of the Regional Delegates Conference that:

1 Greater unity is desirable in furthering the interests of the engineering profession.

2 Greater unity can best be accomplished by continuing and extending the activities of the Engineers Joint Council.

3 Unity organizations of the council type should be organized at the local level (Area to be determined by the needs of the sections and by political subdivisions.)

4 A direct channel of communication between the national unity organization and the local unity organizations should be established and between the local unity organizations and the sections of the participating societies.

5 All members of the national unity organization should be members of the participating societies.

6 Financial support of the national and local unity organizations should come from the national organizations of the participating societies.

The Council, at its meeting June 10–11, 1951, voted to approve the statement of opinion of the Regional Delegates Conference on Unity of the Engineering Profession and forward it as the view of the Council to the ASME represen-

tative on the Exploratory Group, E. J. Kates. This has been done.

Since that action the Council has vigorously supported the progress of Engineers Joint Council in becoming the recognized unity organization of the entire engineering profession. Three additional national engineering societies have joined EJC, to increase its membership to eight, and invitations to others have been issued. EJC has taken steps to effectuate the recommendations of the Exploratory Group and has appointed committees to work on (*a*) affiliating with EJC the various state and regional unified groups and also individuals; (*b*) clarifying the relations between EJC and the National Society of Professional Engineers; (*c*) merging Engineers' Council for Professional Development with EJC.

EJC is amending its Constitution and By-Laws to suit its functions as a broadened unity organization.

Full reports on the foregoing will be published in MECHANICAL ENGINEERING.

E. J. Kates, ASME representative on the Exploratory Group on Unity of the Engineering Profession and an alternate representative of ASME on Engineers Joint Council, made an oral report on progress in unification to the Regional Delegates Conference on June 28, 1953.

The Council voted to approve items 24 and 31A.

Agenda Topic No. 11A: The RDC requests that a special report for the record be submitted by the Council to the immediate past and the present National Agenda Committee, the membership of the RDC and Section Chairmen, showing action on RDC Agenda Items within one month after action has been taken.

Delegates' Action: CARRIED UNANIMOUSLY

Council Action: The Council voted to authorize the transmission of the portion of its meeting minutes reporting action on RDC recommendations as suggested in this item.

Agenda Topic No. 11A: The National Agenda Committee is requested by the RDC to include with the second compilation for the RAC meetings, those items from the previous RDC meeting which have received no action from Council.

Delegates' Action: CARRIED UNANIMOUSLY

Council Action: The National Agenda Committee reports that it will comply with the request.

As the control of the National Agenda is in the hands of the National Agenda Committee, the Council believes that action on this item is unnecessary.

Agenda Topic No. 39: It is proposed that the Council appoint a committee to study the problem of publishing the *Journal of Applied Mechanics* and the Transactions of the ASME on a basis that will make them available to the membership at their request.

Delegates' Action: CARRIED UNANIMOUSLY

Council Action: The Board on Technology and the Publications Committee are conducting a study, looking to the possible grouping of related material in issues of Transactions. A special committee of the Publications Committee presented a report which was approved by the Board on Technology and upon its recommendation, the report was approved by the Council on November 29–30, 1953. The report reviewed the policy prior to 1948, the present publication plan, and suggested changes.

New Business

Agenda Topic: That the 1953 Regional Delegates Conference requests the 1954 Agenda Committee to do the following:

1 Prepare and distribute to the Sections a set of suggestions on how to write agenda items so they will contain a definite proposal in a form suitable for simple rejection or approval action.
2 Analyze agenda items submitted for ambiguous and unsuitable form and refer those considered defective back to the writer with suggestions for improvement. It is recognized that if the writer insists, the committee must accept the item as written.
3 Include on the instruction sheet attached to the agenda prepared for the Regional Administrative Committee Meetings the request that if an item is, in the opinion of the committee, unsuitable for intelligent action by simple approval or rejection, the committee submit a motion of its own stating its views on the item.
4 Include on the instruction sheet attached to the agenda prepared for the Regional Delegates Conference a similar request to that contained in Item 3 afore-mentioned.
5 Include in the agenda prepared for the Regional Delegates Conference the special actions taken by the Regional Administrative Committees under Item 3 foregoing as well as their votes of approval or rejection.
6 Add to the foregoing any measures which they believe will further expedite the preparation and processing of the agenda.
7 Report to the 1954 Regional Delegates Conference upon their success with this plan as a guide for action of future agenda committees.
8 Report to 1954 RDC action of Council on Agenda Items passed by the 1953 RDC.
9 Maintain and keep up to date Index and Record established by 1952 Agenda Committee, under leadership of W. H. Byrne. This includes distribution to Sections of necessary additions.

Delegates' Action: CARRIED UNANIMOUSLY

Council Action: The National Agenda Committee reports that it will comply with the request.

It is worth while to point out that twelve favorable actions were taken by the 1953 RDC. An equal number of unfavorable actions were taken. Of the twelve favorable actions, four dealt with the National Agenda, two dealt with unity, two dealt with Society policies, and the remaining four were items dealing with procedure.

The Council voted that this is a matter for the Regional Delegates to determine for themselves.

Copies of this report are available by writing to the Secretary, ASME, 29 West 39th Street, New York 18, N. Y.

EUSEC Conference Held in Paris

Representatives From Engineering Societies of Western Europe and the U. S. A. Conferred on a Wide Program of Importance

THE conference of representatives from the Engineering Societies of Western Europe and the United States of America was held in Paris, France, September 7–11, 1953. Twenty-eight delegates convened from 12 countries; U. S. A. was represented by Walter L. Huber, president ASCE; Elgin B. Robertson, president AIEE; and W. N. Carey, secretary ASCE; C. E. Davies, secretary ASME; and H. H. Henline, secretary AIEE.

The discussions included such topics as the possibility of creating a professional code of ethics, ways of improving the semiannual bulletin established by EUSEC after The Hague Conference, and the result of efforts to obtain the close co-operation of EUSEC with such similar international groups as the Conference of Engineering Institutions of the British Commonwealth and the Conference of Engineering Societies of the Western Hemisphere (UPADI).

Abstracting Services in the Engineering Field

Acting on the report of the working party appointed in 1949 to study the abstracting services in the engineering field in reference to information covering existing abstracting services now in operation, how to co-ordinate the services to avoid overlapping and duplication, how to provide fuller coverage, and to make recommendations for circulation by the Secretariat to the participating Societies, the Conference recommended: 1 That the participating Societies of EUSEC recognize that an adequately co-ordinated service of engineering abstracts is likely to prove of ever-growing value to their members and that they should take steps to acquaint their members of the benefits which the regular use of such abstracts can bring. 2 That the participating Societies

continue to take steps to ascertain the nature of the service desired, both by taking their members' views on the range of subjects which they would wish an engineering abstracting service to comprise, and by corresponding inquiries among interested bodies such as university laboratories, research organizations, and the like. 3 That the participating Societies should continue to place emphasis on the necessity for insuring that summaries of engineering papers and articles which they publish are of good quality and suitable to form the basis of an abstract. 4 That if the short list of selected abstracting services now in preparation by the working party is approved by an exchange of letters between the participating Societies, the Societies shall undertake to make available to those selected abstracting services, free of charge, the summaries referred to in Recommendation 3. Mr. Davies is chairman of the working party which in the U. S. A. is working with a similar group of Engineers Joint Council.

Professional Engineer, Engineering Technician Defined

The definitions of the terms "Professional Engineer" and "Engineering Technician," which were approved by the Conference, were also approved by Engineer's Council for Professional Development and read as follows: A *professional engineer* is competent by virtue of his fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He is able to assume personal responsibility for the development and application of engineering science and knowledge, notably in research, designing, construction, manufacturing, superintending, managing, and in the education of the engineer. His work is predominantly intellectual and varied, and not of a routine mental or physical character. It requires the exercise of original thought and judgment and the ability to supervise the technical and administrative work of others.

His education will have been such as to make him capable of closely and continuously following progress in his branch of engineering science by consulting newly published work on a world-wide basis, assimilating such information, and applying it independently. He is thus placed in a position to make contributions to the development of engineering science or its applications.

His education and training will have been such that he will have acquired a broad and general appreciation of the engineering sciences as well as a thorough insight into the special features of his own branch. In due time he will be able to give authoritative technical advice and to assume responsibility for the direction of important tasks in his branch.

Engineering Technician

An *engineering technician* is one who can apply in a responsible manner proved techniques which are commonly understood by those who are expert in a branch of engineering, or those techniques specially prescribed by professional engineers.

Under general professional-engineering direction, or following established engineering techniques, he is capable of carrying out duties which may be found among the list of examples set out below.

In carrying out many of these duties, competent supervision of the work of skilled craftsmen will be necessary. The techniques employed demand acquired experience and knowledge of a particular branch of engineering, combined with the ability to work out the details of a task in the light of well-established practice.

An engineering technician requires an education and training sufficient to enable him to understand the reasons for and purpose of the operations for which he is responsible.

The following duties are considered as typical of those carried out by engineering technicians: Working on design and development of engineering plant and structures; erecting and commissioning of engineering equipment and structures; engineering drawing, estimating, inspecting, and testing engineering construction and equipment; use of surveying instruments, operating, maintaining, and repairing engineering machinery, plant, and engineering services, and locating defects therein; activities connected with research and development, testing of materials and components, and sales engineering, servicing equipment, and advising consumers.

Engineering Education

The conference adopted the recommendations made by the delegates who attended the EUSEC Conference on Engineering Education held in London, England, in January, 1953, and announced that the second conference would be held in Zurich, Switzerland, Sept. 27, 1954. The U. S. A. members of EUSEC arranged for ECPD to provide representation at the first conference and plan to do so for the Zurich conference.

Visiting Lecturers

The conference decided to set up a working party to examine the policies and procedures of the participating societies in connection with invitations to lecturers from outside their own countries to deliver both individual addresses and courses of instruction, with a view to improving existing arrangements and making recommendations to a future conference of EUSEC covering the entire situation. The working party is composed of the following personnel: C. E. Davies, U. S. A.; H. Sangster, The Netherlands; O. Åkerman, Sweden; and Brian G. Robbins, secretary, United Kingdom.

The conference accepted an invitation extended by the Dansk Ingeniorforening to act as hosts to the conference at a meeting in Copenhagen, Denmark, to be held in 1955.

Westinghouse Sends 15 Men to Harvard

Harvard Selects Candidates for Training in Business Administration

As PART of a company-wide management-development program, Westinghouse Electric Corporation sent 15 men to The Harvard Graduate School of Business Administration to take a special 16-month course which began February 2. This is the course that was first announced by Harvard last June.

Lloyd A. Russ, director of management development for Westinghouse, who made the announcement, said the 15 men will study for master of business administration degrees while receiving their regular salaries from the company. Westinghouse will pay their tuition and fees, and also such expenses as travel and books.

Purpose of the Course

"The purpose of this course," Mr. Russ explained, "is to expose promising young men to a comprehensive education in the fundamentals of business and general management at an early stage of their careers.

"These men, whose average age is 31 and average years with the Company is 7¼, have acquired enough experience and business maturity to enable them to profit more from such training than would be possible immediately following their undergradute education. Equally important, they have not become too fixed in outlook and thinking habits to receive full benefit of this type of education."

If the Company's experience with this Graduate Business Administration Course is favorable, Mr. Russ said, Westinghouse will consider continuing the program in future years, sending groups made up principally of men with five to seven years of company experience and under 34 years of age. Final selection of men to take the course is made by the Director of Admissions of Harvard Business School from candidates selected by Westinghouse from all parts of the company. The 15 who entered February 2 were selected by Harvard from 53 nominated by the company for consideration this year.

Management Training

"Management-training programs are one of the principal tools employed in the Westinghouse management-development program," Mr. Russ explained. "Closely akin to this training is a carefully planned program of guiding work experience through rotational assignments. These techniques are used in addition to regular appraisal of individual performance, counseling, and self-development help. The Harvard graduate course is but one of several training programs employed."

Others, the Westinghouse executive said, include: advanced management programs consisting of short courses for business executives at Harvard, the University of Pittsburgh, Columbia, Stanford, and Northwestern Universities; two-week business and management courses conducted at the Westinghouse Educational Center in Pittsburgh, Pa., and a Westinghouse policy course—a two-week course for management personnel in Company policies and practices.

In addition to selecting and developing men for a so-called "management reserve" group which includes nearly 1000 individuals, the Westinghouse management-development program also is intended to expose all members of management and others with management potential to opportunities for self-improvement and advancement in accordance with their current abilities, Mr. Russ explained. In all, the total number of employees covered by the management-development program is approximately 11,000.

The Group Selected—Statistics

The group of 15 Westinghouse men selected by Harvard for the MBA course includes men of widely varying backgrounds. One of the "students" already has a bachelor's degree in electrical engineering, a master's degree in communications engineering, and a doctor's degree in applied physics. Another has no college degree. Nine of the 15 completed the Westinghouse graduate-student training course following their graduation from college.

Five of the group now are engaged in engineering with the company, while four are in manufacturing, five in sales, and one in purchasing. From the standpoint of product groups, five men are in consumer product divisions, two in defense products, six in apparatus products, one in general industrial products, and one is in research.

The youngest man is 26, the oldest 33, and experience with Westinghouse ranges from 4 3/4 years to 11 years. Each of the 15 men has agreed to remain in Westinghouse employ for a period of at least five years from the time he commences the Harvard course.

Literature . . .

Drainage Fittings

An American Standard, Cast-Brass Solder-Joint Drainage Fittings, ASA B16.23-1953, cosponsored by the Heating, Piping, and Air Conditioning Contractors' National Association, the Manufacturers Standardization Society of the Valve and Fittings Industry, and The American Society of Mechanical Engineers, has been published by the ASME. This Standard covers description, pitch (slope), abbreviations for end connections, sizes, and method of designating openings for reducing fittings, marking, minimum requirements for material, and dimensions and tolerances. It contains 11 tables with diagrams. Copies of the Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

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An American Standard, Cast-Iron Screwed Drainage Fittings, ASA B16.12-1953, cosponsored by the Heating, Piping, and Air Conditioning Contractors National Association, the Manufacturers Standardization Society of the Valve and Fittings Industry, and The American Society of Mechanical Engineers, was published by ASME. This Standard covers: Dimensions of threaded ends, center-to-end dimensions of elbows, dimensions of tees, crosses, and Y-branches, couplings, increasers, offsets, Tucker Y-branch, Tucker and roof connections, and P-traps, bath traps, and running traps. It contains 13 tables and an appendix. Copies of this Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y. for $1 a copy.

Letter Symbols for Radio

An American Standard, Letter Symbols for Radio, ASA Y10.9-1953, sponsored by The American Society of Mechanical Engineers, has been published by the ASME. The Standard covers general principles of letter symbol standardization, special symbols for use in radio, and alphabetical lists of symbols in order of quantity and symbol. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Spindle Noses and Arbors

An American Standard, Spindle Noses and Arbors for Milling Machines, ASA B5.18-1953, cosponsored by the Metal Cutting Institute, the Society of Automotive Engineers, the National Machine Tool Builders' Association, and The American Society of Mechanical Engineers, was published by ASME. This Standard covers essential dimensions of spindle nose, essential dimensions for ends of arbor and adapter, and dimensions of draw-in bolt end. It contains tables and figures. Copies of the Standard may be purchased from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Acme Screw Threads

An American Standard, Acme Screw Threads, ASA B1.5-1952, cosponsored by the Society of Automotive Engineers and The American Society of Mechanical Engineers, has been published by the ASME. This Standard is a revision of American War Standard on Acme Screw Threads, B1.59-1945. It covers specifications, classifications, and tolerances for general purpose and centralizing Acme threads including angle, pitch, height, and thickness of thread, basic diameters and thread designations. The Standard contains 26 tables and five figures. It has two appendixes. Copies of the Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $2.25 a copy.

Preferred Thicknesses

An American Standard, Preferred Thicknesses for Uncoated Thin Flat Metals (Under 0.250 In.), ASA B32.1-1952, cosponsored by the Society of Automotive Engineers and The American Society of Mechanical Engineers, has been published by the ASME. This Standard is a revision of ASA B32.1-1941. This Standard contains a simplified system for designating the thickness of uncoated, thin, flat metals and alloys by decimal parts of an inch. It contains one table. Copies of this Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Gas Piping Systems

An American Standard, Gas Transmission and Distribution Piping Systems, ASA B31.1.8-1952, sponsored by The American Society of Mechanical Engineers, has been published by the ASME. This Standard is Section eight of American Standard Code for Pressure Piping, ASA B31.1-1951. The Standard is divided into six chapters: Introduction, Piping Components, Pipe Joints, Fabrication Details, Requirements After Installation, and Tables and Illustrations. It contains 15 illustrations and several tables. Copies of this Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1.25 a copy.

Mounting Dimensions

An American Standard, Mounting Dimensions of Lubricating and Coolant Pumps for Machine Tools, ASA B5.28-1952, cosponsored by the Metal Cutting Tool Institute, the Society of Automotive Engineers, the National Machine Tool Builders' Association, and The American Society of Mechanical Engineers, has been published by the ASME. This Standard covers mounting dimensions of foot-mounted, bracket-mounted, and motor-mounted pumps. It contains six tables with diagrams. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Plain Washers

An American Standard, Plain Washers, ASA B27.2-1953, cosponsored by the Society of Automotive Engineers and The American Society of Mechanical Engineers, has been published by the ASME. This Standard covers dimensions of plain washers intended for general industrial applications. It contains one table and diagram. Copies of this Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., at $1 a copy.

Illustrations

A Proposed American Standard, Illustration Standards for Publications and Projections, Y-15.1, has been published by The American

Society of Mechanical Engineers. This Standard covers legibility standards, copy for publications, and copy for projections. It contains figures and tables. An appendix on drafting practices and materials and a bibliography are also included. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y.

Letter Symbols for Meteorology

An American Standard, Letter Symbols for Meteorology, ASA Y10.10-1953, sponsored by The American Society of Mechanical Engineers, has been published by the ASME. The American Meteorological Society collaborated on the Standard. It covers general principles of letter symbol standardization, special principles for use in meteorology, and letter symbols for meteorology. Copies of the Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Pressure Piping

An American Standard, Code for Pressure Piping, ASA B31.1a-1953, sponsored by The American Society of Mechanical Engineers, has been published by the ASME. This Standard is supplement No. 1 to ASA B31.1-1951. It covers Allowable S values for pipe in power piping systems, Allowable S values, psi, for pipe in oil piping systems within refinery limits, allowable S values for pipe in district heating piping systems, and pressure-temperature ratings for American Standard cast and forged 5 per cent chrome-molybdenum alloy steel valves, fittings, and flanges when used with other than ring joints. It contains tables. Copies may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., at $1 a copy.

Small Solid Rivets

An American Standard, Small Solid Rivets, ASA B18.1-1953, sponsored by the Society of Automotive Engineers and The American Society of Mechanical Engineers, has been published by the ASME. This Standard covers tabular sizes, proportions and dimensions, and tolerances of flat head, countersunk head, button head, pan head, truss head, tinners', coopers', and belt rivets. It contains eight tables. Copies of this Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1 a copy.

Involute Spline and Serration Gages and Gaging

An American Standard, Involute Spline and Serration Gages and Gaging, ASA B5.31-1953, cosponsored by the Metal Cutting Tool Institute, the Society of Automotive Engineers, the National Machine Tool Builders' Association, and The American Society of Mechanical Engineers, has been published by the ASME. This Standard covers types of gages used for different types of fits, factors which affect fits, control of fits, working and inspection gages, and operation of control systems. It contains 11 figures and 16 tables. Copies of the Standard may be obtained from the ASME Order Department, 29 West 39th Street, New York 18, N. Y., for $1.25 a copy.

Education . . .

Fellowships

Ethyl Corporation is continuing its graduate-fellowship program for the academic year 1953–1954, by supporting fellowships in 21 universities in the fields of chemistry, chemical engineering, mechanical engineering (internal-combustion engines), and physics.

A total of $40,000 is contributed for this purpose to cover stipends, tuition, and fees. This is in addition to special research projects which are supported at a number of universities.

The institutions in the Ethyl fellowship program this year for research are: California Institute of Technology, Massachusetts Institute of Technology, University of Michigan, and University of Wisconsin.

Candidates in their final year of study for a doctor's degree are given preference but awards are also supported for other graduate students.

The Ethyl fellowship program was initiated in 1938 to encourage the development of outstanding research personnel and fundamental research.

Educational Awards

Ten International Education Awards for 1954, nine in the United States and one in Canada, for full-time engineering students interested in pursuing tool and production engineering as a profession, were announced by the American Society of Tool Engineers.

Grants will be paid directly to the institution on a quarter or semester basis to a total of $700 a year. Although awards are made on an annual basis, the student must maintain satisfactory grades to receive the balance of the award.

Eligible students are as follows: A third-year student in a four-year curriculum; a third or fourth-year student in an undergraduate five-year curriculum; or a fourth-year student who will continue graduate work in the following fifth year. His course of studies must include those that prepare him for future work in tool and production engineering.

Awards will be made by the ASTE on the basis of the application form plus any additional data the student may care to present.

The form should be submitted together with the recommendation of a screening committee which may consist of faculty members and the local Chapter Education Committee of the ASTE.

A faculty counselor or adviser is a preferred reference. Application forms have been sent to the deans of engineering of 129 engineering schools approved by the Engineers' Council for Professional Development. The completed application form, together with the letters of recommendation, must reach the American Society of Tool Engineers, ASTE International Awards, 10700 Puritan Avenue, Detroit 38, Mich., not later than March 31, 1954.

AEC Fellowships

Applications for U. S. Atomic Energy Commission Fellowships in Radiological Physics and Industrial Hygiene for the 1954–1955 school year are now being received by the Oak Ridge Institute of Nuclear Studies.

The Industrial Hygiene fellowship program supports a limited number of individuals who are studying for the master's degree in this field at the Harvard University School of Public Health and the University of Pittsburgh Graduate School of Public Health.

Radiological Physics fellowships are carried out in three separate programs as follows: At Vanderbilt University and Oak Ridge National Laboratory, Tenn.; at the University of Rochester and Brookhaven National Laboratory, Upton, L. I., N. Y.; and at the University of Washington and Hanford Works, Wash. In each case, nine months of course work at the university is followed by three months of additional study and field training at the co-operating AEC installation. Up to 25 fellows may be appointed in each of the three programs. Course work may be applied toward an advanced degree.

Application forms and additional information may be obtained from the Fellowship Office, University Relations Division, Oak Ridge Institute of Nuclear Studies, P. O. Box 117, Oak Ridge, Tenn.

Graduate Assistantships

Missouri School of Mines and Metallurgy offers several opportunities to qualified graduate students for appointment to graduate assistantships during 1954–1955. Applications are invited from men holding either a BS or an MS degree in special fields.

Graduate assistantships requiring about half-time teaching duties are open in the departments of mining, metallurgy, geology, ceramics, chemistry, physics, and electrical, civil, and mechanical engineering. The assistantships, which are renewable, carry a first-year stipend of $1000 for the academic year, September 1 to May 31. The yearly stipend is, respectively, $1100 and $1200 if the graduate assistantship is awarded consecutively for a second year and third year of service and study.

These opportunities permit the student to carry two thirds of a normal program of graduate study leading to an MS degree or to higher academic training in any of the aforementioned respective fields of interest. Appointees pay fees amounting to approximately $75 a semester.

Coming Meetings . .

Marine Corrosion

THE tentative program for the two-day conference on marine-corrosion problems to be given by the University of California, Berkeley, Feb. 8 and 9, 1954, has been announced.

On Monday morning, February 8, lectures will be given on environmental and biological factors in marine corrosion; in the afternoon, selection of materials for marine service and marine paints. The session on Tuesday morning will be devoted to cathodic protection for marine-service piling, docks, ships, drilling rigs, wells, and off-shore pipe lines. The afternoon studies will cover tanker corrosion, corrosion in laid-up ships, and a panel discussion on special topics will be held.

The registration fee is $10.

Materials Handling

PURDUE University will hold its fourth Materials-Handling Conference on February 17–18. The meeting is to be cosponsored by the Indianapolis chapter of the American Materials Handling Society.

George Smith, of International Business Machines Corporation, Endicott, N. Y., who is national president of the Society, will be the keynote speaker for the conference. His topic will be "The Road Ahead in Materials Handling."

Industrial leaders and teachers, all specialists in the rapidly growing field of materials handling, will present discussions on mechanization and human relations, handling waste materials, effective utilization of industrial trucks, work sampling, materials handling in the modern foundry, latest developments in packaging, and some concepts of storage-space layout and stock location.

Harold T. Amrine, Mem. ASME, of the industrial-engineering section at Purdue University, is general chairman for the meeting which will be held in the Memorial Union building on the campus.

Air Pollution

THE second annual symposium on air pollution and its control will be held at Wagner College, Staten Island, N. Y., on Saturday, March 6, 1954, from 9:30 a.m. to 4:30 p.m.

The panel of lecturers will include authorities in the fields of public health, agriculture, and engineering, as well as air-pollution control officials of governmental agencies and industry.

The symposium will be under the auspices of the Department of Bacteriology and Public Health of Wagner College. Dr. Natale Colosi is the chairman.

Engineering Societies Personnel Service, Inc.

THESE items are from information furnished by the Engineering Societies Personnel Service, Inc., in co-operation with the national societies of Civil, Electrical, Mechanical, and Mining and Metallurgical Engineers. This Service is available to all engineers, members, or nonmembers and is operated on a nonprofit basis.

In applying for positions advertised by the Service, the applicant agrees, if actually placed in a position through the Service as a result of an advertisement, to pay a placement fee in accordance with the rates as listed by the Service. These rates have been established in order to maintain an efficient nonprofit personnel service and are available upon request. This also applies to registrant members whose availability notices appear in these columns. Apply by letter, addressed to the key number indicated, and mail to the New York office.

When making application for a position include six cents in stamps for forwarding application to the employer and for returning when necessary. A weekly bulletin of engineering positions open is available at a subscription of $3.50 per quarter or $12 per annum for members, $4.50 per quarter for nonmembers, payable in advance.

New York	Chicago	Detroit	San Francisco
8 West 40th St.	84 East Randolph St.	100 Farnsworth Ave.	57 Post St.

Men Available[1]

Draftsman-Estimator, 31, married, experienced in piping, mechanical, structural; desires position involving close contact with shop and field. Presently on AEC project in East. Prefers South or Far West. Me-47.

Mechanical Engineer, 28, heat-transfer equipment design, development, and research experience in chemical, petroleum, and domestic-heating fields. Teaching and graduate-work background. Desires position demanding engineering and supervisory responsibility. Me-48.

Production Engineer, BME, 29, married. Three years' experience in metal-parts manufacturing, three years in design. Desires challenging position. Capable of administrative as well as technical effort. New York metropolitan area. Me-49.

[1] All men listed hold some form of ASME membership.

Executive Assistant, ME, 34, married, ten years' top-level sales-engineering and sales-management experience industrial machinery. Export and domestic. Desires position with more administrative responsibility. Me-50.

Mechanical Engineer, MSc, PhD, University of Wisconsin, 36, single, experienced, interested in research work in theoretical or experimental stress analysis and applied mathematics. Teaching job also acceptable. Me-53.

Engineer, P.E., New York, 20 years' experience with engineering firm in charge design and construction of steam plants, industrial buildings, and their facilities. Conducted studies covering generation and utilization of steam and power. Prefers New York, N.Y. Me-54.

Industrial Engineer, seven years' experience including three years' supervising industrial group. Registered. Standards, budgetary control, wage incentives, methods, plant layout, job evaluation, standard cost accounting. BSME, married. Prefers Midwest. Me-55.

Assistant Professor, 30, married, MS in hydraulics, PhD in engineering mechanics. Three years' experience in research and teaching undergraduate and graduate mechanics courses. Desires teaching and/or conducting research. Available June. Me-56-790-Chicago.

General Manager, chief engineer, research director, or sales manager, 34, experienced in metals fabrication, production machining, government contracts, labor relations, management functions. Registered ME and CE. Prefers southern location. Me-57.

Positions Available

Mechanical Engineers for consulting engineering firm. Should be young, minimum of five years' experience in design of public-utility power stations. Location, Pa. Y-9451.

Production Superintendent, at least five years' experience covering machine-shop operations, chemical cleaning, glass forming, assembly and test of transmitter tubes. $8000. Long Island, N. Y. Y-9471.

Plant Engineer, mechanical graduate, minimum of five to ten years' experience in plant engineering and maintenance, to overhaul and install equipment—air conditioning and conveyers—for large food company. $8000. New York metropolitan area. Y-9472.

Assistant Chief Engineer, 35–45, mechanical graduate, for company building automatic vending machines. Must have considerable engineering, machine-shop and sheet-metal shop experience. $8000. Conn. Y-9475.

Chief Design Engineer, 35–45, five to ten years' experience in design of machine tools, small power tools used in light-metal manufacturing. $10,000, plus bonus. Northern N. J. Y-9506.

Engineers. (*a*) Production engineer, mechanical graduate, 28–35, three to five years' experience in production work, particularly where heavy machinery is involved. Company manufactures brick and tile. $6000–$8000. Western Pa. (*b*) Industrial engineer to set up and correct statistical methods, standards of operation, etc., for company in brick and tile business. Will not be responsible for production, but related to research and development. $6000–$8000. Western Pa. Y-9521.

Chief Engineer, 35–50, minimum of ten to 15 years' experience in internal-combustion engines, pumps, motors, or similar experience, preferably with product-development background. $20,000–$25,000. New England. Y-9540.

Administrative Engineer, 40–45, mechanical, electrical, or equivalent, extensive experience in the electromechanical field, including strong design ability. Will manage special-products plant of 150 employees which will be expanded to include design-engineering group and increased manufacturing facilities. Salary open. East. Y-9546-D-9042.

Chief Engineer, 40–50, for food-process equipment manufacturer. Should have considerable experience in process-food or bakery equipment. Should have a creative mind and be able to confer with customers. $10,000–$18,000. Pa. Y-9549.

Mechanical Engineer, graduate, 30–35, to work as assistant to chief engineer and be groomed for that position. Should have some experience in combustion engineering, heat transfer, and heat application. Company manufactures industrial-heating burners, portable-heating equipment, etc. $5200–$5720. New York metropolitan area. Y-9551.

Draftsman and Detailers, mechanical, structural, electrical, and industrial, plant layout, minimum of five years' board experience. $5400–$6000. Northern N. J. Y-9557.

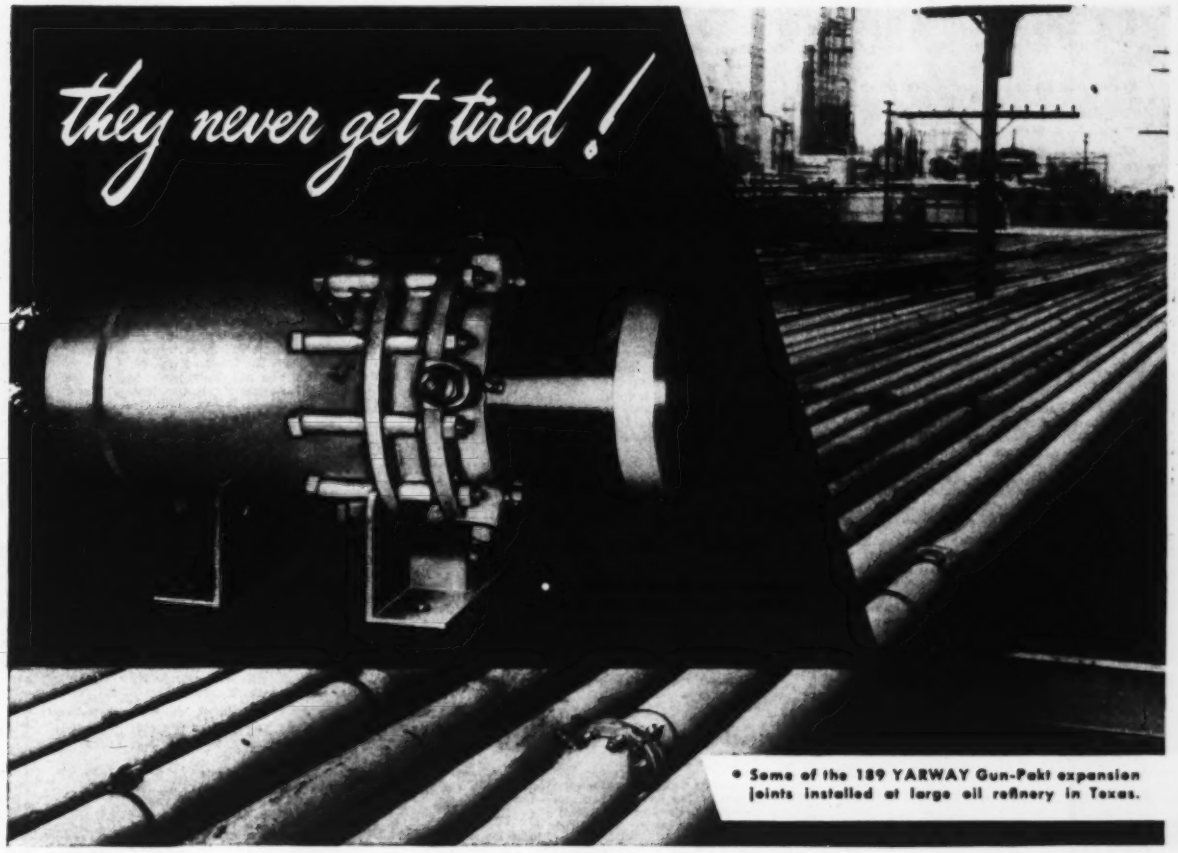
Chief Engineer, mechanical, for large manufacturer of sheet-metal and electromechanical component parts. $10,000–$12,000. N. H. Y-9559.

Industrial Engineer, five years' experience, preferably in time study, wage incentives, methods analysis, and factory layout, for a metal-processing industry. $6500–$7200. New York metropolitan area. Y-9563.

Design Engineer, stress analysis and design experience covering high-pressure and high-temperature piping for power and chemical plants. $7800. New York, N. Y. Y-9567.

Industrial Engineer, experience in production-management fields, to make surveys of production techniques, analyze findings, and prepare reports for distribution to members of management-research organization. Must be able to write

(*ASME News continued on page 220*)



• Some of the 189 YARWAY Gun-Pakt expansion joints installed at large oil refinery in Texas.

No fatigue with 189 YARWAY GUN-PAKT EXPANSION JOINTS at this large Texas refinery

THEY just work and work for years and never get tired. Yarway Gun-Pakt slip-type joints simply will not fail through fatigue. They will operate smoothly, as frequently as required, over long, full traverse up to 12" single type or 24" double type or short, partial traverse, day in and day out—with never any danger of metal fatigue or failure.

This is just one of the many big advantages found in Yarway Gun-Pakt expansion joints. Other outstanding Gun-Pakt features are:

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3. Lower pressure load on end anchors because excessive strains are eliminated.

Used for many years with success in well-known refineries, industrial plants, utilities and institutions. When replacing present joints or planning new steam lines, it will pay you to look into the advantages of the Yarway Gun-Pakt expansion joint. Write for Yarway Bulletin EJ-1913.

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gun-pakt expansion joints

ucidly. Up to $7200. New York, N. Y. Y-9569.

Production Engineer, mechanical graduate, tool and die-design experience in light-metal fields for aluminum-foil-products manufacturer. $6000. Newark, N. J. area. Y-9570.

Mechanical Engineer, 35, graduate, preferably with industrial background or someone who has had materials-handling background. Work will be basically industrial engineering confined to materials handling. Must have had plant-operating experience. Salary, plus bonus. Some traveling. Headquarters, Conn. Y-9572.

Mechanical, Mining, or Construction Engineer, to 50, graduate, ten years' experience. Knowledge of mechanical, mining, or construction engineering. Will supervise 300-400 multiplant operations. Will direct, oversee, and control large-volume distribution of limestone aggregates, sand, and compounded redi-mix concrete. Background in design of equipment used in quarries. $10,000. Employer will pay fee. Ill. C-1488(*a*).

Chief Industrial Engineer, 30-40, degree preferred, to convert plant of 1600 employees from 50-50 Halsey to standard-hour plan. Compiling standard data; direct 25 industrial engineers on maintenance of incentive plans, indirect labor controls, cost-reduction programs, standards, procedures and methods, plant layout, etc., for a manufacturer of wood and steel products. $10,000-$12,000. Wis. C-1489(*a*).

Plant Superintendent, up to 50, at least three years' experience in general precision machine shop on heavy products. Will supervise about 100, including machinists and supervisors, production, labor relations, tooling, inventory, production control, and inspection for a manufacturer. $9000, plus bonus. Employer may negotiate placement fee. Minn. C-1493.

Plant Superintendent, mechanical preferred, 30-45, at least three years' experience in supervisory work in sheet-metal fabrication, machine shop, or foundry. Knowledge of integrating all functions of production departments. Will supervise all production departments, consisting of nine foremen of various operations, production controls, tooling and line balancing, industrial engineering, quality controls, and cost-reduction programs for a manufacturer of metal caps. $7000-$8000. Employer will negotiate placement fee. Ill. C-1495.

Director of Design and Development, 30-45, industrial or mechanical, at least ten years' experience in design of production equipment. Knowledge of industrial engineering and tooling. Will direct activities handling tooling and industrial-engineering projects covering design and development of jigs, fixtures, and other production equipment. $8400-$9600. Kan. C-1502.

Tooling Engineer, 35-50, three years' experience in modernizing production equipment, and processing machine-shop operations. Knowledge of woodworking helpful. Will modernize production equipment and processing orders for production, for a manufacturer of pianos. $7000-$8000. Employer will pay fee. Ill. C-1508.

Development Engineer—Aeronautical, eight years' or more experience in structures work on heavy bombers or heavy commercial planes. Will do research and development on heavy aircraft structures for a manufacturer of electronics. Up to $15,000. Employer will negotiate placement fee. Ill. C-1524(*b*).

Chief Engineer, up to 55, at least four years' experience in precision plastic molding and finishing, either molding or fabrication. Will supervise design, tooling, estimating, plant layout, processing, and production of and for plastics for a manufacturer. $10,000-$12,000. Ill. C-1550.

Change in Grading

Transfers to Member, Associate Member, or Affiliate

BOOIJ, MAX L., Stamford, Conn.
DAVEY, JOHN T., Toledo, Ohio
FELLINGER, ROBERT C., Ames, Iowa
KAUFFMAN, GEORGE E., Canton, Ohio
MAXIN, RAYMOND, Philadelphia, Pa.
MILES, HUGH S., JR., Blacksburg, Va.
MILLEVILLE, BERTRAM J., Homewood, Ill.
MOULTON, LLOYD J., Mentor, Ohio
MOYER, EDWIN L., Jamesville, N. Y.
ROHSENOW, WARREN M., Cambridge, Mass.
SMITH, RAYMOND W., Akron, Ohio
URBINA, DANIEL S., Long Beach, Calif.
WADE, DEFORREST V., Savannah, Ga.
WALSH, EDWIN F., Richmond, Va.
WEST, ROBERT F., Caldwell, N. J.

Transfers from Student Member to Associate Member 60

Candidates for Membership and Transfer in the ASME

THE application of each of the candidates listed below is to be voted on after Feb. 25, 1954, provided no objection thereto is made before that date and provided satisfactory replies have been received from the required number of references. Any member who has either comments or objections should write to the Secretary of The American Society of Mechanical Engineers immediately.

Key to Abbreviations

R = Re-election; Rt = Reinstatement; Rt & T = Reinstatement and Transfer to Member

New Applications

For Member, Associate Member, or Affiliate

ANDREAE, PIERRE, V., Chattanooga, Tenn.
ARBOGAST, A. BRUCE, Elkhart, Ind.
ARNT, CHESTER, J., Chicago, Ill.
BAADER, CHARLES, J., 2ND, Asbury Park, N. J.
BASTRESS, ERNEST K., JR., Rochester, N. Y.
BEASLEY, ELMER G., JR., Mountain City, Tenn.
BEDINGER, JOSEPH A., Van Nuys, Calif.
BENNETT, HARRY R., Lombard, Ill.
BOGAN, JOSEPH A., SR., Elizabeth, N. J.
BOSTON, ROBERT C., Pasadena, Calif.
BOWMAN, JOHN W., Washington, N. J.
BRANSTROM, DONALD F., Seattle, Wash.
BRICKER, THEODORE R., Columbus, Ohio
BROW, EDWARD W., Park Forest, Ill.
BROWN, NORMAN H., Kansas City, Mo.
BROWN, WILLIAM, Park Forest, Ill.
BURN, DONALD R., Charlotte, N. C.
CARTER, SIDNEY A., Los Angeles, Calif.
CHARWAT, ANDREW F., Los Angeles, Calif.
CHIKOFSKY, SONNY, Whitestone, L. I., N. Y.
CLARK, DAVID L., Buechel, Ky.
COFFMAN, IRVING L., Bartlesville, Okla.
DELK, JOHN R., Memphis, Tenn.
DIAZ, AMBROSE A., New York, N. Y.
DICKINSON, LAWRENCE, Hamilton, Ont., Can.
DOLHOF, LESLIE J., Hudson Falls, N. Y.
DOWD, EDWARD M., Framingham, Mass.
DREYER, HENRY F., New York, N. Y.
EDELMAN, ALBIN D., Boonton Manor, N. J.
EICHENBERGER, HENRY F., Doylestown, Pa.
ENGELHARDT, HARRY L., Lake Jackson, Texas
FAULKENBERRY, FORREST W., Johnstown, Pa.
FENNEMA, THAD S., Baytown, Texas
FYFE, IAN M., Elsmere, Del.
GARRETT, RANKIN F., Houston, Texas
GILBERT, RAYMOND D., Richland, Wash.
GLASS, ALEXANDER, Wheeling, W. Va.
GOMMEL, DEWEY E., Indianapolis, Ind.
GRETTUM, VICTOR C., Rapid City, S. Dak.
GROSS, LESTER P., New York, N. Y.
GUDE, JOHN W., W. Caldwell, N. J.
GUPTA, BHAGWAT P., Dehra Dun, U. P., India
GYGI, HANS A., Ct. Aargau, Switzerland
HARDISON, EUGENE D., Arlington, Va.
HILL, WALTER C., JR., Wilmington, Del.
HINING, VERDUS L., Cactus, Texas
HOFFMAN, SHIRLEY F., East Orange, N. J.
HOKANSON, MAX L., Chicago, Ill.
HOLTON, ROY T., New Bern, N. C.
HUNT, DAVID A., West Arcadia, Calif.
ILLGNER, JACK E., Kansas City, Mo.
JANKOWSKI, STANLEY P., Philadelphia, Pa.
JARRARD, HUMAN H., Birmingham, Ala.
JOHNSON, GEORGE C., Los Angeles, Calif.
KECK, JULIAN W., Miami, Fla.
KEILER, ARTHUR R., New Orleans, La.
KIMBALL, DUANE E., Marblehead, Mass.
KLAPPER, GERHARDT E., Philadelphia, Pa.
KLOSNER, JEROME M., Farmingdale, L. I., N. Y.
LATINO, VITO A., Springfield, Mass.
LAWRENCE, SHERWOOD H., Detroit, Mich.
LELEU, LUCIEN, Pas-de-Calais, France
LEMON, ALTON T., Philadelphia, Pa.
LEWIS, JAMES D., Chicago, Ill.
LIDDLE, ALFRED H., JR., Warwick, R. I.
LINDBERG, HAROLD C., Dewitt, N. Y.
LONDONO, R. HERNAN, Medellin, Colombia, S. A.
LUBAHN, JACK D., Schenectady, N. Y.
MANNING, JOHN P., Woburn, Mass.
MARTIN, HARRY W., Middletown, Ohio
MAYER, MAYER, JR., New Orleans, La.
McGAVOCK, GURDON P., Roanoke, Va.
McSHANE, WILLIAM J., Pittsburgh, Pa.
MOORE, WILLIAM W., Plainfield, N. J.
MORIN, DAN, St. Louis, Mo.
NOLTE, CLAUDE B., Los Angeles, Calif.
OCHS, ROBERT E., JR., Philadelphia, Pa.
PALMER, WILLIAM R., Philadelphia, Pa.
PETERS, RALPH C., Philadelphia, Pa.
POLLARD, ROBERT L., Fond du Lac, Wis.
RAUCH, TRAVIS N., Bridgeville, Del.
RIDGRAVE, GILBERT R., Moylan, Pa.
RICHTER, JERRY G., State College, Pa.
RIETMANN, EDWARD A., New York, N. Y.
RIMMER, STANLEY M., Bristol, Conn.
ROBERTS, FRED T., JR., Lakewood, Calif.
SAWYER, PAUL H., San Francisco, Calif.
SCHAFFER, JOHN W., Chicago, Ill.
SCHIKSS, JUSTIN F., New York, N. Y.
SCHWARM, EVERETT W., Forest Hills, N. Y.
SHARP, WILLIAM H., Pittsburgh, Pa.
SHARPNACK, EDWIN V., SR., Louisville, Ky.
SHAW, ALLAN, New York, N. Y.
SIMCOX, CLIFFORD G., Oldbury, England
SMITH, ROSCOE B., Palo Alto, Calif.
TARASOV, LEO P., Worcester, Mass.
THAYER, MATTHEW H., Poquonock Bridge, Conn.
THOMPSON, DONALD M., Alexandria, Va.
TIMBER, CHARLES W., Westfield, N. J.
TOWNE, DONALD B., Bridgeport, Conn.
TREWHELLA, STEPHEN W., Columbia, S. C.
TURNER, HERBERT D., Copenhagen, Denmark
VERMA, UMA K., Manbhum, Bihar, India
WAGGENER, JAMES P., Havertown, Pa.
WAITE, CALVIN L., Poughkeepsie, N. Y.
WARING, LAWRENCE E., Boston, Mass.
WARREN, EDWARD W., Hazardville, Conn.
WEIMAN, KARL K., Brooklyn, N. Y.
WELLS, SHELDON E., Hubbard, Ohio
WERDERICH, LOUIS J., Chicago, Ill.
WHITAKER, RICHARD F., Wilmington, Del.
WOLF, JAMES E., Van Nuys, Calif.
WRIGHT, JOHN H., New York, N. Y.
WU, NING G., Berkeley, Calif.
YAGLE, RAYMOND A., Ann Arbor, Mich.
YELPO, JOSEPH R., Union City, N. J.
YOUNG, WALTER M., Baltimore, Md.
ZIEGLER, MALCOLM P., Baton Rouge, La.
ZIBETTE, REGINALD R., JR., Old Greenwich, Conn.

Obituaries . . .

Clarence Herbert Bean (1879-1953)

C. H. BEAN, engineering consultant, Byrne Associates, New York, N. Y., died Aug. 14, 1953. Born, Rock Falls, Ill., May 23, 1879. Parents, Jason P. and Mary E. Bean. Education, BS, University of Illinois, 1903. Married, Emma Clark Hunn, 1909; son, Sherman H. Mem. ASME, 1915. He was the author of several technical papers. For nine years he served on the Bound Brook, N. J., Board of Education; from 1933 to 1934 he was president.

Bruce Corson (1921-1953)

BRUCE CORSON, industrial engineer, Kroger Co., Cincinnati, Ohio, was killed in Cleveland, June 25, 1953. Born, Detroit, Mich., March 21, 1921. Education, BS(ME), University of Michigan, 1943; MSE, 1949. Jun. ASME, 1949. Survived by wife.

Louis Albert de Cazenove (1878-1951)

LOUIS A. DE CAZENOVE, whose death was recently reported to the Society, was a retired engineer of Theological Seminary, Alexandria, Va. He died in 1951. Born, Theological Seminary, Alexandria, Va., Dec. 2, 1878. Education, ME, Cornell University, 1902; MME, 1903. Jun. ASME, 1905; Mem. ASME, 1911. Survived by Edith P. de Cazenove.

Cedric Keith Ferguson (1922-1953)

CEDRIC K. FERGUSON, research engineer, Oil-Field Research Division, California Research Corp., La Habra, Calif., died Aug. 12, 1953. Born, Walsenburg, Colo., June 2, 1922. Parents, Kenneth S. and Lucille (McWhorter) Ferguson. Education, BA, Stanford University, 1943; MS, University of California, 1948. Married Vera Phelps, 1946. Author of several technical papers. Jun. ASME, 1943.

Edward Jay Franklin (1871-1953)

EDWARD J. FRANKLIN, former chief mechanical engineer, Utah Copper Corp., died Oct. 31, 1953, at his home in Encino, Calif. Born, Newport,

(*ASME News continued on page 222*)

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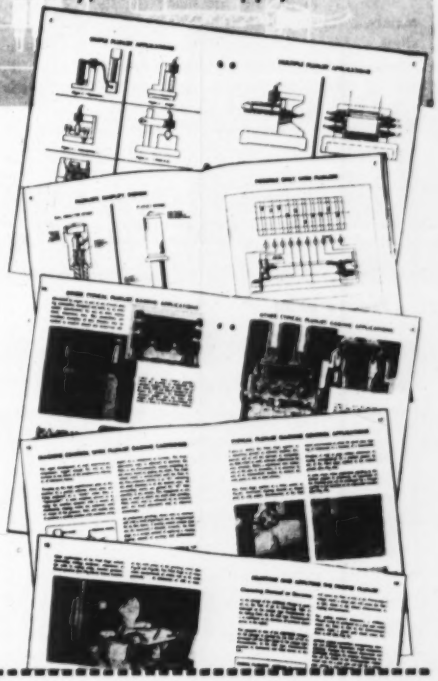

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MASTER CRAFTSMAN SHEFFIELD HEADQUARTERS

SHEFFIELD

Ky., April 28, 1871. Education, private instruction, L. L. Gregson, Newport, Ky.; Dr. C. G. Plummer, Los Angeles, Calif. Mem. ASME, 1913. He was one of the leaders in designing power plants for mines; also instrumental in the electrification of plant operations. Survived by his wife, Esther.

Walter Adolph Giger (1895–1953)

WALTER A. GIGER, consulting engineer, Allis-Chalmers Manufacturing Co., Norwood, Ohio, died in Switzerland, Sept. 25, 1953. Born, Zurich, Switzerland, Dec. 18, 1895. Education, graduated with state diploma in electrical engineering in 1920, Swiss Polytechnical Institute. Married Vera M. Rueger, 1928; children, Walter, Jr., Brietta. Mem. ASME, 1948. He held several patents on locomotive control systems and wrote many articles covering the subject.

Robert Everett Hall (1871–1953)

ROBERT E. HALL, retired sales engineer, who specialized in hydraulic engineering and power-plant equipment, died Oct. 15, 1953. Born, Brooklyn, N. Y., March 15, 1871. Parents, George F. and Mary (Powers) Hall. Education, ME, Stevens Institute of Technology, 1895. Married Elizabeth Learned, 1900; children, Mary L., Elizabeth, Robert E., Jr., Frederic L. Jun. ASME, 1898; Mem. ASME, 1905.

Leroy Francis Harza (1882–1953)

LEROY F. HARZA, president, Harza Engineering Co., Chicago, Ill., died Nov. 22, 1953. Born Brookings, S. Dak., Feb. 6, 1882. Parents, William F. and Clara Samantha (Jolly) Harza. Education, BS(ME), South Dakota State College, 1901; BS(CE), University of Wisconsin, 1906; CE, 1908; hon. DE, South Dakota State College, 1950. Married Zelma (Davidson) Hoffman, 1922. Mem. ASME, 1919. He was a U. S. delegate, World Power Conference, Berlin, 1930; fourth Congress on Large Dams, Bombay, 1951. Author of many papers published in technical periodicals. He received a University of Wisconsin citation, 1949; John Croes Medal, ASCE, 1950. Survived by wife; a son, Richard D.; and a stepson, Arthur C. Hoffman.

James Christian Heide (1926–1953)

JAMES C. HEIDE, application engineer, Dynamatic Co. of Eaton Manufacturing Corp., Kenosha, Wis., died Sept. 22, 1953. Born, Kenosha, Wis., Aug. 5, 1926. Parents, Christen P. (formerly works manager, Nash Motors) and Anna (Rasmussen) Heide. Education, graduate St. Johns Military Academy, 1944; BS(ME), Marquette University, 1951. Married Betty Jane Adelsen, 1950. Jun. ASME, 1951. Survived by wife and two children, Peter T., Jamie Beth (born two months after father's death); his parents; three brothers, Donal C., Charles H., Rev. Robert S., all of Kenosha; and two sisters, Mrs. K. W. Jensen, Kenosha, Mrs. Otto Seeglitz, La Mesa, Calif.

Warren Johnson (1875–1953)

WARREN JOHNSON, retired, formerly with Todd-Johnson Dry Docks, Inc., New Orleans, La., died March 13, 1953. Born, New Orleans, La., Dec. 5, 1875. Parents Lewis and Rosena (Smith) Johnson. Education, BE, Tulane University, 1896; BAr, Cornell University, 1897. Married Elizabeth Merrick, 1901 (died 1903); daughter, Elizabeth M. Assoc. ASME, 1904.

Robert McIntosh (1880–1953)

ROBERT MCINTOSH, retired, mechanical superintendent, Calumet & Hecla Consolidated Copper Co., Calumet, Mich., died Oct. 17, 1953. Born, Grinnell, Iowa, Jan. 12, 1880. Parents, Andrew and Addie Cornelia (Ricker) McIntosh. Education, PhB, Grinnell College, 1901; ME, Cornell University, 1905. Married Katherine Henderson, 1906; son, Fred. Mem. ASME, 1913.

Marvin E. Nulsen (1893–1953)

MARVIN E. NULSEN, manufacturers' representative, Indianapolis, Ind., died Oct. 1, 1953. Born, Cincinnati, Ohio, Nov. 28, 1893. Parents, Albert W. and Elsa L. (Roth) Nulsen. Education, BS, Cooper Institute of Technology, 1914; ME, 1919; ME, Columbia University, 1920. Married Belinda C. Kirk, 1928. Assoc. Mem. ASME, 1921; Mem. ASME, 1927.

Gilbert Cameron Polk (1889–1953)

GILBERT C. POLK, vice-president, secretary, American Blower Corp., Detroit, Mich., died several months ago, according to a notice received at headquarters. Born, Raymond, Neb., Sept. 27, 1889. Parents, Lurton F. and Jeanette (Morgan) Polk. Education, BS, University of Nebraska, 1913. Married Nancy Buckerfield, 1919; son, Robert L. M. Mem. ASME, 1933.

C. Stanley Robinson (1901–1953)

C. STANLEY ROBINSON, principal power engineer, engineering department, E. I. du Pont de Nemours & Co., Inc., died in Wilmington, Del., Nov. 3, 1953. Born, Lowell, Mass., Dec. 12, 1901. Education, BS, Massachusetts Institute of Technology, 1923. Married Anna Monahan, 1933. Jun. ASME, 1924; Assoc-Mem. ASME, 1931; Mem. ASME, 1935. Survived by wife and three children, John B., Gerald B., Joan C.

Robert William Salisbury (1879–1952)

ROBERT W. SALISBURY, retired mechanical engineer, Texas & Pacific Railway, died Oct. 15, 1952, according to a notice recently received by the Society. Born, Volcano, W. Va., Jan. 28, 1879. Parents John and Isabel M. (Blacklin) Salisbury. Education, BS, Pennsylvania State College, 1901. Married Sara B. Harter, 1903. Mem. ASME, 1916. He served the Society on the general committee, RR2, Railroad Division. Survived by daughter, Mrs. Don B. Christian, Irving, Texas.

Norbert James Walker (1896–1953)

NORBERT J. WALKER, assistant to the mechanical engineer, Philadelphia (Pa.) Electric Co., died Nov. 1, 1953. Born, Raven Run, Pa., Aug. 22, 1896. Education, BS(ME), Villanova College, 1923. Married Mary O'Hara. Mem. ASME, 1936. He was the author of many technical papers published in professional journals. Survived by wife; a son, Norbert J. Jr.; and two brothers, John and Vincent.

Keep Your ASME Records Up to Date

ASME Secretary's office in New York depends on a master membership file to maintain contact with individual members. This file is referred to dozens of times every day as a source of information important to the Society and to the members involved. All other Society records and files are kept up to date by incorporating in them changes made in the master file.

From the master file are made the lists of members registered in the Professional Divisions. Many Divisions issue newsletters, notices of meetings, and other materials of specific interest to persons registered in these Divisions. If you wish to receive such information, you should be registered in the Divisions (no more than three) in which you are interested. Your membership card bears key letters opposite your address which indicate the Divisions in which you are registered. Consult the form on this page for the meaning of the letters. If you wish to change the Divisions in which you are registered, please notify the Secretary's office.

It is important to you and to the Society to be sure that your latest mailing address, business connection, and Professional Divisions' enrollment are correct. Please check whether you wish mail sent to home or office address.

For your convenience a form for reporting this information is printed on this page. Please use it to keep the master file up to date.

Four weeks are required to complete master-file changes.

ASME Master-File Information

(Not for use of student members)

Please print **Check mailing address**

Name.....
Last First Middle

Home address..... ☐
Street City Zone State

Name of employer.....

Address of employer..... ☐
Street City Zone State

Product or service of company.....

Title of position held.....

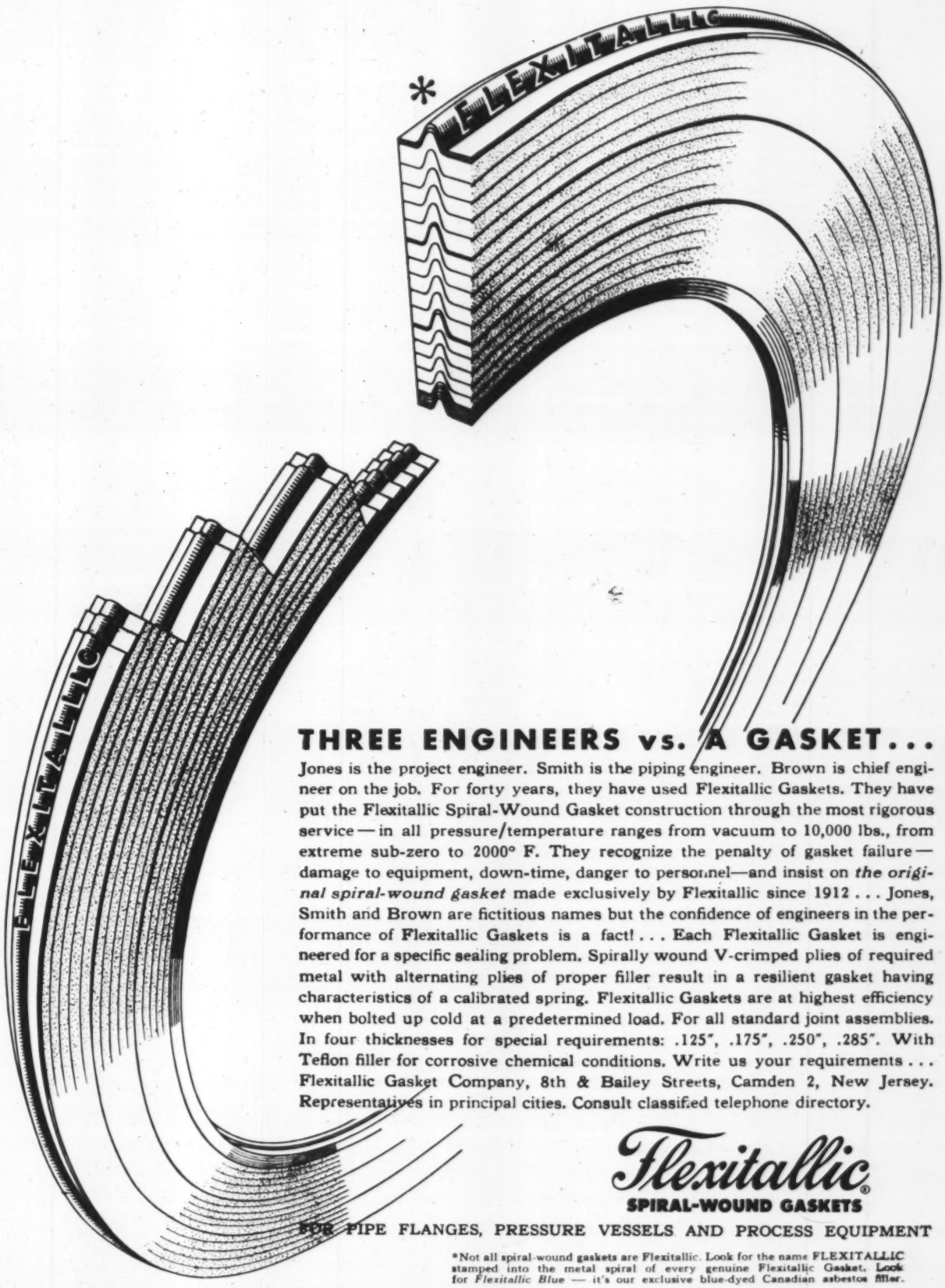
Nature of work done.....

Please register me in three Professional Divisions as checked:

☐ A—Aviation
☐ B—Applied Mechanics
☐ C—Management
☐ D—Materials Handling
☐ E—Oil and Gas Power
☐ F—Fuels
☐ G—Safety
☐ H—Hydraulics
☐ J—Metals Engineering
☐ K—Heat Transfer
☐ L—Process Industries
☐ M—Production Engineering
☐ N—Machine Design
☐ P—Petroleum
☐ R—Railroad
☐ S—Power
☐ T—Textile
☐ V—Gas Turbine Power
☐ W—Wood Industries
☐ Y—Rubber & Plastics
☐ Z—Instruments and Regulators

I am a subscriber to (please check)

Transactions.. ☐ Journal of Applied Mechanics.. ☐ Applied Mechanics Reviews.. ☐



THREE ENGINEERS vs. A GASKET...

Jones is the project engineer. Smith is the piping engineer. Brown is chief engineer on the job. For forty years, they have used Flexitallic Gaskets. They have put the Flexitallic Spiral-Wound Gasket construction through the most rigorous service — in all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. They recognize the penalty of gasket failure — damage to equipment, down-time, danger to personnel—and insist on *the original spiral-wound gasket* made exclusively by Flexitallic since 1912 . . . Jones, Smith and Brown are fictitious names but the confidence of engineers in the performance of Flexitallic Gaskets is a fact! . . . Each Flexitallic Gasket is engineered for a specific sealing problem. Spirally wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring. Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". With Teflon filler for corrosive chemical conditions. Write us your requirements . . . Flexitallic Gasket Company, 8th & Bailey Streets, Camden 2, New Jersey. Representatives in principal cities. Consult classified telephone directory.

Flexitallic®
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

*Not all spiral-wound gaskets are Flexitallic. Look for the name FLEXITALLIC stamped into the metal spiral of every genuine Flexitallic Gasket. Look for *Flexitallic Blue* — it's our exclusive blue-dyed Canadian asbestos filler.

for lower cost control of moderately **Corrosive** fluids

Fig. 2651-A Gate

JENKINS

NICKEL IRON

Valves with Type 316

STAINLESS STEEL

Trim

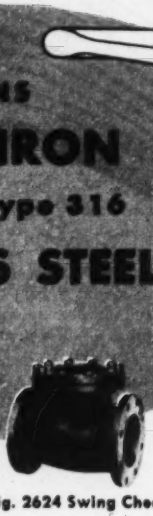
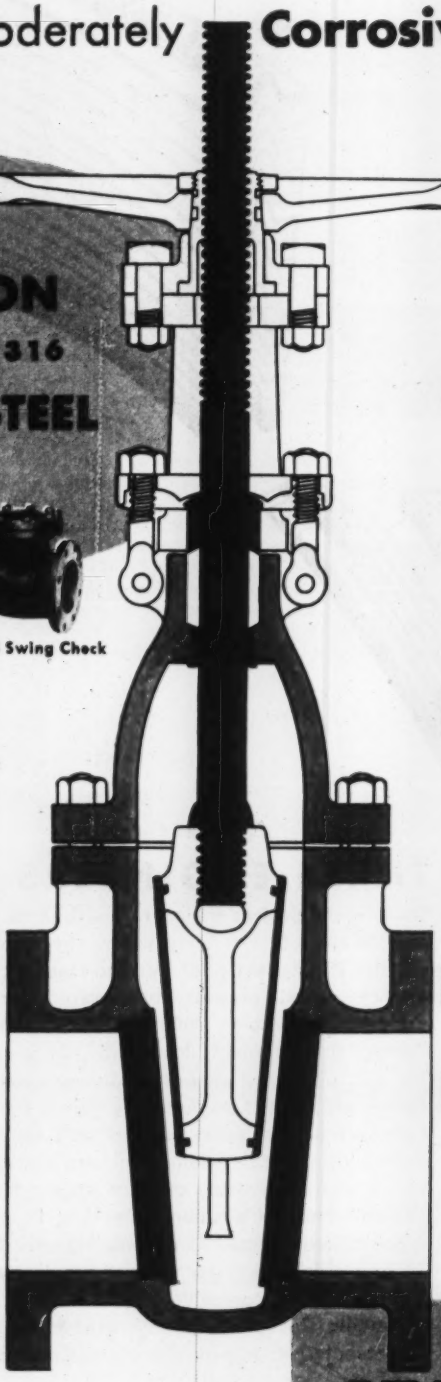


Fig. 2624 Swing Check



Every part in contact with fluid is the right metal to block corrosion and beat wear.

- **BODIES** Heavy duty, dimensioned for greater resistance to wear and abuse. Through port design in Gate Valves.
- **BONNET** Rugged construction, like body. Swing-type gland bolts. Screwed-in back-seating bushing. Deep stuffing box.
- **YOKE** Integral with bonnet in 2" to 4" sizes.
- **WEDGE** In 10" to 24" sizes, with Stainless Steel Wedge Rings.
- **COVER** In Check Valve.

Type 316 STAINLESS STEEL

- SPINDLE
- GLAND
- BONNET BUSHING
- SPINDLE RING
- WEDGE PIN
- WEDGE RINGS Rolled into Nickel Iron Wedge in 10" to 24" sizes.
- SEAT RINGS
- DISC and HANGER in Gate Valve

NI-RESIST Type No. 2

- WEDGE of I-beam structure is solid NI-RESIST in 2" to 8" sizes.

PRESSURE RATINGS

2" to 12"—200 lbs. O.W.G.
14" to 24"—150 lbs. O.W.G.

This combination provides corrosion resistance well above the moderate need in many processing services with an investment well below that for all-stainless steel valves.

Designed primarily for the chemical process industries, they are recommended for control of mildly corrosive liquids with minimum quantities of mineral acids, such as creosote in wood treatment, and many liquids carried in petroleum processing.

A major use is in pulp and paper processing, particularly in lines serving the digester, and in the chemical recovery cycle. Service records in lines carrying the valve-punishing "black liquor" give Jenkins Nickel Iron Valves top performance rating.

Jenkins *extra value* construction throughout. Get details — compare. See why they stretch your valve investment dollar — with longer service life, lower maintenance cost.

GET COMPLETE SPECIFICATIONS from your Jenkins Valve Distributor, or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Bulletin 118.

JENKINS VALVES

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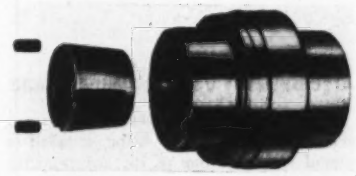
NEW EQUIPMENT | BUSINESS NOTES | LATEST CATALOGS

Available literature or information may be secured by writing direct to the manufacturer. Please mention MECHANICAL ENGINEERING.

NEW EQUIPMENT



C Couplings for Taper-Lock Bushings

For the present, three sizes of Lovejoy Type C Couplings adapted for use with Dodge Taper-Lock Bushings will be available to industry December 15, 1953, according to a recent announcement by Lovejoy Flexible Coupling Co., of Chicago, Ill.

Besides permitting easy fastening to shafting with the firmness of a shrunk-on fit, couplings adapted to Taper-Lock Bushings permit distributors to carry a smaller number of coupling bodies taper-bored for taper-lock bushings. By drawing on their own stock of Dodge Taper-Lock Bushings, they can give the customer immediate delivery on any size bore.

The three sizes of the Lovejoy Type C Coupling which will be available for use with Dodge Taper-Lock Bushings are: C-191 (Dodge Bushing No. 2012) for bores $^1/_2$" to 2"; C-226 and C-276 (Dodge Bushing No. 2517) for $^1/_2$" to 2$^1/_2$" bores.

Lovejoy also continues to stock all sizes of straight bored couplings. For information write: Lovejoy Flexible Coupling Co., 4832 W. Lake Street, Chicago 44, Ill.

Teflon Molded O-Rings

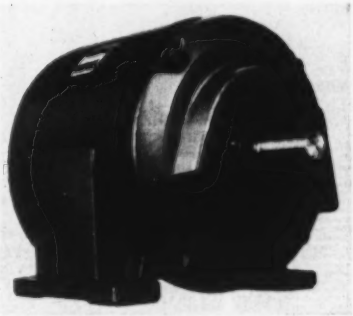
O-Rings of Teflon are being molded, it is announced by an Ohio concern specializing in that plastic. Reportedly, quality and uniformity of O-Rings by the molding process are excellent.

Teflon is Dupont's trademark for its Polytetrafluorethylene Resin, the plastic that is practically chemically inert, nonadhesive and can be used for a range of temperature of −320 F to 500 F.

Although not all of the numerous sizes of O-Rings are presently available, requests for information are invited by The Sparta Heat Treat Co., Plastics Div., East Sparta, Ohio.

Controlled Closing Valve

To prevent surge and water hammer damage when filling pipe lines, control speed of line closure, vent air and, if necessary discharge water to prevent damage and admit air to protect against pipe collapse from line breaks, the Type CCAV valve was perfected by the Simplex Valve & Meter Co., 68th & Upland Streets, Philadelphia 42, Pa. Write for brochure.



A-C Motors

A new line of well protected, versatile squirrel-cage induction motors was announced recently by the Reliance Electric & Engineering Co. The line, including protected and enclosed motors for all industrial purposes, is being built to recently adopted standards of the National Electrical Manufacturers Association.

Research in the fields of new insulating materials, ventilation, heat transfer and more efficient electrical designs by Reliance has made possible greater horsepower in more compact space with equal and in some cases even greater liberality than in past designs. Research has also led to better protection of the motor windings, leads and bearings.

The first of the new Reliance motors to appear will be built for 1, 1$^1/_2$ and 2 horsepower applications, in frame sizes 182 and 184. The balance of the line, up to and including 30 horsepower, will be introduced at regular intervals during 1954 and the early part of 1955. The present Reliance a-c line will continue to be available during this change-over period to fill the needs of those users who wish to complete current projects with motors as they are now being built.

Further data on these new motors, including an informative "Compar-A-Frame Chart," is available on request. Write to the Reliance Electric & Engineering Co., 1088 Ivanhoe Road, Cleveland 10, Ohio.

New Pulpwood Loading Device

A pulpwood loading device which enables the operator to load both sides of a flat car from one side and carries a pay load of 9000 lbs. has been announced by the Clark Equipment Co. Named the "Pulploader," the device is offered as an attachment for the Ross Series 151.H fork lift truck.

Operation of the Pulploader is completely hydraulic and controlled from the driver's seat. The device tilts 92$^1/_2$" from the vertical and can be raised to a height of 26'10". Spliced load cables support the load and are freed through operation of a hydraulic hook release. A unit of pulpwood, usually 1$^3/_4$ cords, can be lifted from a truck and placed on a flat car in one operation.

In operation, the Pulploader is lowered over the unit of pulpwood and the cables are slipped under each end and hooked together under the unit. The unit is then hydraulically raised clear of the truck and the fork-lift tower is tilted into its backward position, allowing the unit to rest against a bumper grill which evens the face of the load.

The fork-lift is then moved to the flat car and the load is lowered into place, either on the near side or the far side of the car. When the load is in position, the cable hooks are disengaged by trip cables actuated by a hydraulic cylinder on the crane arm and controlled by the driver. Cables are withdrawn from the load by raising the Pulploader until the cables are clear. The operator can then even the load by bumping protruding sticks with the heavy bumper grill.

All steel welded construction is used for the Pulploader to assure ruggedness and durability. Cables are hand spliced to prevent fraying. The extra heavy bumper grill measures 78" high and 84" wide.

Further information on the Pulploader can be obtained by writing to the Clark Equipment Co., Industrial Truck Div., Benton Harbor, Mich.

The device is not available for export.

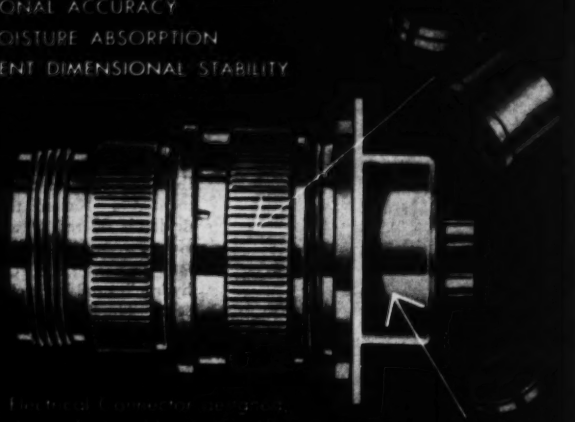
MYCALEX
glass-bonded mica insulation penetrates the design barrier of

temperature endurance!

2000 F
FLAME TEST FOR 20 MINUTES!

ALSO OFFERS THESE IMPORTANT ADVANTAGES

- VERY LOW THERMAL CONDUCTIVITY
- LOW COEFFICIENT OF EXPANSION
- DIMENSIONAL ACCURACY
- ZERO MOISTURE ABSORPTION
- PERMANENT DIMENSIONAL STABILITY



SINCE 1919
MYCALEX
THE INSULATOR

MYCALEX CORPORATION OF AMERICA
World's Largest Manufacturer of Glass Bonded Mica Products
Executive Offices 30 Rockefeller Plaza, New York 20, N. Y.
ADDRESS INQUIRIES TO
General Offices and Plant 126 Clifton Blvd., Clifton, N. J.

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Flex-Tube I-V Gage

An unusually versatile gage for plus, minus and differential readings is announced by F. W. Dwyer Mfg. Co. The new I-V Gage will serve as air filter gage, static pressure indicator, draft gage, air velocity meter, etc. The I-V Gage is equipped with a plunger type oil level adjuster. Ranges are 0–3 in. and 0–7 in. water-low range accuracy of .01 in. water. Also available in a direct reading velocity model for use with a pitot tube, ranges of 0–7000 and 0–10,500 fpm. Furnished complete with tubing and fittings, gage is housed in an attractive, rugged molded plastic housing and said to be priced interestingly low. Complete information by writing to Mr. J. G. Dwyer, F. W. Dwyer Mfg Co., 317 S. Western Ave., Chicago 12, Ill.

Large Butterfly Valve for Wind Tunnel

One of the largest butterfly valves ever built for handling air, is being installed in a wind tunnel of one of the government's aeronautic laboratories. It is to be used to control the volume, speed and pressure of the wind to which planes are subjected in test.

The valve was specially designed and constructed by W. S. Rockwell Co., 200 Eliot St., Fairfield, Conn. It is 96 in. inside diameter with the overall diameter of the flange 108 in. The assembled valve, weighing 7.5 tons, required special transportation arrangements.

Because of its size and special manufacturing conditions, the valve was fabricated of steel, structural members and forgings. One of its unique features is the construction of the shaft bearings. The entire unit was designed to be operated with the blade shaft in any position, so that it was necessary to incorporate a heavy duty, double acting bearing in order to support the weight of the shaft and blade under any operating conditions.

The blade is actuated by a large hydraulic cylinder, 10 in. bore, 51 in. stroke, with oil at 1000 psi as the power medium. A power unit of this size is capable of developing a theoretical torque of 3,300,000 in-lb. The valve has its own hydraulic system complete with motor, pump, accumulator and controls.

The valve was designed to handle air at temperatures up to 390 F, at pressures to 15.3 psi. The maximum pressure differential across the blade in the closed position is 9.7 psi.

Thrust Roller Bearing

A new application of single acting thrust roller bearings has just been introduced by Rollway Bearing Co., Inc., a subsidiary of Lipe-Rollway Corp., both of Syracuse, N. Y.

One of these new bearings, type T-21906, supports a vertical thrust load of 380,000 lbs. at 16 rpm and has a rated capacity of 700,000 lbs.

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

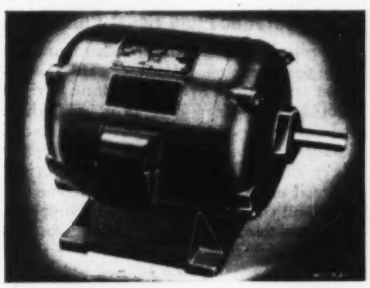
In this instance, the T-21906 roller bearing differs from most applications of single-acting thrust bearings. No center shaft is used to locate the bearing's roller assembly. Instead, a locating ring, which is roll pinned securely to the stationary plate, maintains the roller assembly in perfect alignment.

Locating ring and stationary plate make up the stationary plate assembly, which is ground on its outside diameter to be a slip fit in the housing of the machine to which it is applied.

The T-21906 bearing has additional application advantages. Besides being especially suitable for installations where space is limited, it also can be used on horizontal shaft applications to overcome the common problem of maintaining a sufficient amount of lubricant in the bore of the roller assembly. With the new thrust bearing, oil reaches and remains between the locating ring and the roller assembly, a condition not always evident in standard thrust bearings.

Type T-21906 roller bearing is $25^{3}/_{4}$ in. outside diameter, 17 in. inside diameter and $3^{3}/_{4}$ in. thick.

For further information, write Rollway Bearing Co., Inc., 543 Seymour St., Syracuse, N. Y.



Integral HP Motors

A new line of integral horsepower motors, designed specifically to provide smooth, economical changeover to the new standards prescribed by the National Electrical Manufacturers Ass'n. has been announced by the Electric Motor Div. of the A.O. Smith Corp., Tipp City, Ohio. Production and deliveries are scheduled for January. New motors in either present or new mountings offered.

Initial production, will be in the one, one and one-half and two horsepower ratings. All performance characteristics of the old and new motor lines will be equal. Contour lines and styling will be the same. Only the physical mounting dimensions will vary according to the customers' wishes.

The new Smith design is composed of rolled steel main frame construction with attached malleable iron base mounting as required. End frames are of durable cast iron. They are so constructed as to insure maximum ventilation to working interior parts, yet they meet requirements of "drip proof application."

STEAM UNITS IN THE TIME WITH

Heat-Kwik

Super-Silvertop Steam Traps

Interested in getting more production out of your steam-consuming units? Then equip them with the new Heat-Kwik Super-Silvertop Steam Traps. One of the most important steam trap developments in our times, Heat-Kwiks heat up units in 1/8th the time of ordinary inverted bucket traps . . . three times as fast as so-called air eliminator or blast type traps. Everywhere users are adopting these phenomenal traps as the answer to fast heating up, more production, and lower steam consumption. You, too, can save money by standardizing on Heat-Kwiks. See your Super-Silvertop distributor or mail coupon for further information.

SUPER-SILVERTOPS...
Quality Steam Traps Since 1886

The V. D. ANDERSON Company
1930 West 96th Street • Cleveland 2, Ohio
Please send me a copy of your Bulletin 1153 describing Heat-Kwik Steam Traps.

Name_____Title_____

Address_____

City_____State_____

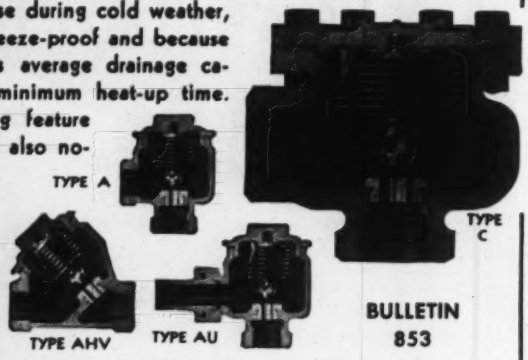
ANDERSON

NICHOLSON MAKES

Freeze-Proof Steam Traps

for every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates heat transfer in severe weather. Types for every plant use. Size ¼" to 2", pressures to 250 lbs.

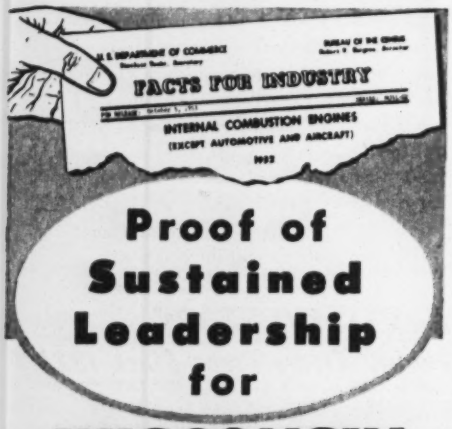


BULLETIN 853

219 OREGON ST., WILKES-BARRE, PA.

W. H. NICHOLSON & CO.

TRAPS · VALVES · FLOATS



Proof of Sustained Leadership for

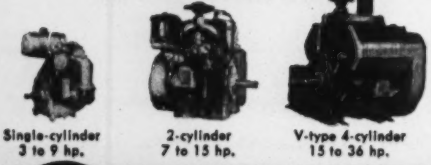
WISCONSIN HEAVY-DUTY Air-Cooled ENGINES

Again official U. S. Government statistics provide proof of Wisconsin Air-Cooled Engine leadership, based on figures contained in the Bureau of The Census release, Oct. 5, 1953.

These statistics, compiled from reports received by the Census Bureau from 94 manufacturers of Internal Combustion Engines, indicate that Wisconsin Motor Corporation produced more engines within our horsepower range, than all other engine manufacturers combined — exclusive of automotive, aircraft, outboard marine, and engines made by machinery manufacturers for use on their own equipment. This includes all Census Bureau classifications from 11 to 175 cu. inch piston displacement.

The aggregate average of Wisconsin Heavy-Duty Air-Cooled Engines produced within the above power classifications, amounts to more than 50% of the total . . . in excess of the combined output of the other 93 engine manufacturers.

This Proof of Preference should be of interest to original equipment purchasers, users, distributors and dealers because it is indicative of outstanding Customer Satisfaction . . . based on Wisconsin Engine Structural and Operating Power Advantages. It pays to stay with a "Winner."



Single-cylinder 3 to 9 hp. | 2-cylinder 7 to 15 hp. | V-type 4-cylinder 15 to 36 hp.

MOST H.P. HOURS

WISCONSIN MOTOR CORPORATION

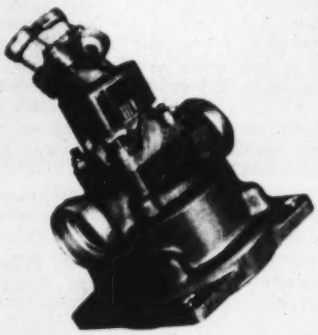
World's Largest Builders of Heavy-Duty Air-Cooled Engines

MILWAUKEE 46, WISCONSIN

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

This new line of motors will supplement the present fastgrowing line which extends from ¼ through 150 H.P. and includes not only standard models but many mechanical and electrical variations from standard to meet customer's specific requirements.

Included in these variations is a complete line of all standard flange mountings, a line of vertical hollow shaft motors for turbine pumps, gear head motors of one through 15 H.P. and many others as required for design application.



New Hydraulic Fluid Boost Pump

A new hydraulic fluid booster pump is being produced at Vickers, Inc. This is a reservoir mounted, hydraulic motor driven accessory. The new product is used where hydraulic reservoirs are located an extended distance from the system hydraulic pumps or where altitude problems exist. It provides reservoir oil under pressure to overcome line losses and assures that an adequate supply of oil is available at the main system pump (s). It is not necessary to pressurize a reservoir when the booster pump is used.

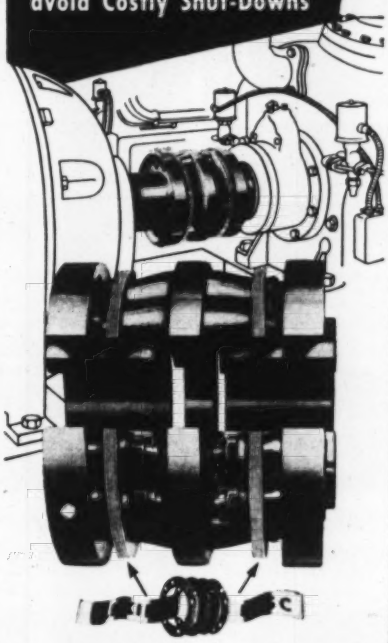
A conventional Vickers 3000 PSI MF-3906 motor is combined with the two stage booster pump. Fluid is bled off the main hydraulic system to power the motor which turns the pump. Gravity feeds reservoir oil into the first stage of the boost unit, a centrifugal pump. The centrifugal section then passes the oil to the vane pump section which generates hydraulic system supply pressures up to 100 PSI.

The new model AA 15500 series oil booster pump can generate hydraulic power varying between 5 GPM at a differential pressure of 100 PSI and 35 GPM at a differential pressure of 18 PSI. The new pump and motor combination weighs 9.1 pounds. It may be mounted in any position which will provide sufficient fluid head to the booster pump.

Depending on the motor size used, delivery from the booster pump is 23 to 33 times greater than the fluid flow through the driving hydraulic motor.

A new brochure No. 5228 describing the hydraulic fluid boost pump may be secured by writing to Vickers, Inc., 1400 Oakman Blvd., Detroit 32, Mich.

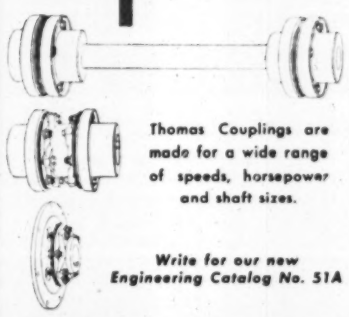
Specify THOMAS ALL METAL
FLEXIBLE COUPLINGS
for Power Transmission to avoid Costly Shut-Downs



Patented Flexible Disc Rings of special steel transmit the power and provide for parallel and angular misalignment as well as free end float.

DISTINCTIVE ADVANTAGES

FACTS	EXPLANATION
NO MAINTENANCE	Requires No Attention. Visual Inspection While Operating.
NO LUBRICATION	No Wearing Parts. Freedom from Shut-downs.
NO BACKLASH	No Loose Parts. All Parts Solidly Bolted.
CAN NOT "CREATE" THRUST	Free End Float under Load and Misalignment. No Rubbing Action to cause Axial Movement.
PERMANENT TORSIONAL CHARACTERISTICS	Drives Like a Solid Coupling. Elastic Constant Does Not Change. Original Balance is Maintained.



Thomas Couplings are made for a wide range of speeds, horsepower and shaft sizes.

Write for our new Engineering Catalog No. 51A

THOMAS FLEXIBLE COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

KEEP INFORMED — NEW EQUIPMENT · BUSINESS NOTES · LATEST CATALOGS

"Packaged Installations"

Lake Erie Engineering Corp., Kenmore Station, Buffalo 17, N. Y., has just announced a newly created service by which industrial customers can purchase "packaged installations" of complete Lake Erie production equipment, set up in their plant, ready to operate.

As a part of this service, Lake Erie Engineering will survey the customer's hydraulic press or die casting requirements and make specific recommendations. They will design, manufacture, supply and install all the basic machinery, tools and dies, conveyors, loading mechanisms, furnaces and other related auxiliaries. Their field force will install or supervise the installation of the complete equipment in the customer's plant—place the equipment in operation and train the supervisory and production personnel. Lake Erie Engineering will assume the responsibility for the satisfactory operation of the equipment as an integrated plant.

This plan—actually a consolidation of all the specialized services offered by Lake Erie—is designed to eliminate piece-meal purchasing and the resultant divided responsibility.

New 1½-HP Motor To Jet-Pump Line

A new $1^1/_2$-hp jet-pump motor that weighs only 30 lbs. has been announced by the General Electric Company's General Purpose Component Motor Department, Schenectady, 5, N.Y.

An addition to the company's line of jet-pump motors beginning with $^1/_4$ hp, the new unit is 30 to 60 per cent lighter than similar motors presently on the market, according to G-E engineers. It will carry the same high loads as other $1^1/_2$-hp jet-pump motors, they said.

Available in single and polyphase open models, it can be mounted either horizontally or vertically, conforms to standard NEMA mounting and shaft dimensions, and is interchangeable with ratings down to $^1/_4$ hp.

Two NEMA $^5/_8$-in. diameter shafts are offered: a cold-rolled steel shaft $1^7/_8$ in. long with a keyway, and a stainless-steel shaft with a standard thread. Rated at 3450 rpm, the new motor is available at $^{115}/_{230}$ volts, 60 cycle, single phase, and $^{208\text{-}230}/_{460}$ volts, $^{60}/_{50}$ cycles, polyphase. All single-phase units have automatic reset thermal protection.

Leads of color-coded braidless neoprene, automotive type grease fittings, and locked bearings are among the features of the new G-E motor. Use of a capacitor helps start heavy loads and reduces in-rush current to aid in eliminating light flicker on the starting cycle. A specially designed ventilation system draws air through the motor to give increased cooling. A drip cover is available as an accessory.

The motor's insulation system, using polyester film in the slots and "Formex" wire windings, is resistant to the effects of moisture, aging, oils, mild acids and alkalies, and heat-cold shock.

Get the Facts!
about WATER HAMMER
and how you can
ELIMINATE THIS COSTLY NUISANCE
with

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Yes—you can put an end to costly, dangerous water hammer in your piping system—NOW—with Williams-Hager Flanged Silent Check Valves. Compact and durable, they can be installed without special tools—in any position. Built for years of silent service, they are available in standard pipe sizes from 1" to 20". Investigate today!

WRITE FOR BULLETIN WH-851

This bulletin contains all the facts about water hammer—its cause, effect and control. Write for your copy!

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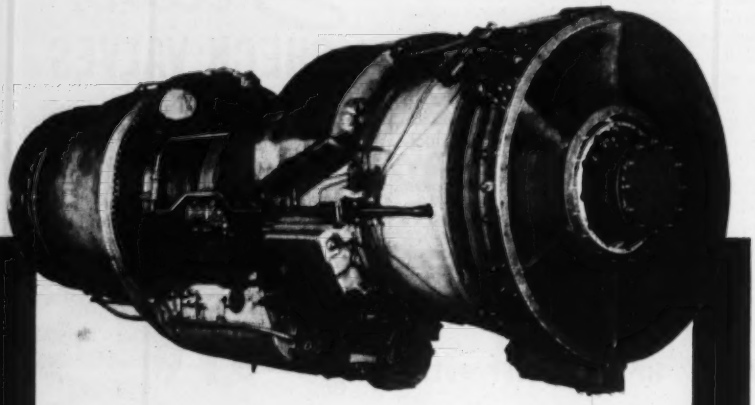
The most powerful turbojet engine known to be in production is Pratt & Whitney Aircraft's J-57. Design of the axial-flow engine incorporates an arrangement of dual compressors in line giving a high compression ratio and unusual fuel economy. Among others the J-57 powers the Boeing B-52 Stratofortress, the North American F-100 SuperSabre, the Convair F-102, the McDonnell F-101 Voodoo and the Navy's Douglas F4D fighter and A3D attack aircraft.



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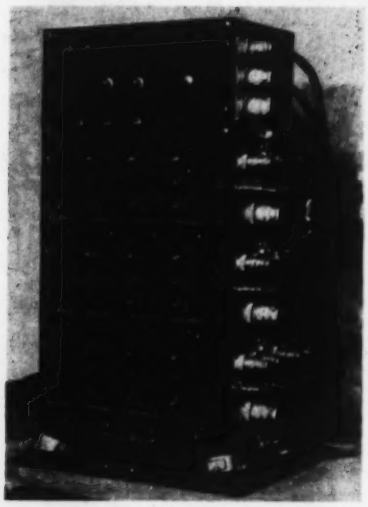

Increase Range of Amplifier System

Consolidated Engineering's unitized, multichannel Amplifier System "D" now offers extended carrier-amplifier range and increased data capacity. Both linear-integrating and carrier amplifier units may be used in any combination up to a maximum of 12 to permit simultaneous use of self-generating and externally-excited pickups. Physical phenomena in the 0-5000 cycles per second range may be amplified and system output coupled to any recording oscillograph equipped with galvanometers of matched characteristics.

Highly versatile, the system may be used with the following types of transducers: Capacitance, Inductance, Reluctance, Resistance, Piezo-Electric, and Photo-Electric, as well as types developed in the laboratory for specific test instrumentation requirements. Thus, a single oscillograph record may contain indications of strain, pressure, acceleration, vibratory displacement, and velocity. Rugged, light-weight construction and wide temperature operating range ($-10°$ C to $+40°$ C ambient) permit use under varied conditions, including laboratory, field, and flight-test applications.

The single-channel amplifier units plug into stacking, four-channel capacity cases, with all input, output and power connections made automatically upon insertion to eliminate intricate wiring. Front panel mounted controls provide operating convenience.

The Carrier Amplifiers provide uniform frequency response ($\pm 2\%$) from input signals in the 0-600 cycles per second range. (Previous range was 0-500 cps.)

Each incorporates a balance circuit for removing resistive or reactive unbalance from either two or four-arm bridges. The null-balance type bridge circuit maintains linearity under all operating conditions, cancelling temperature effects and providing a zero-reference point unaffected by attenuator setting. A phase-sensitive demodulator provides directional sense for the output signal.

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They may be installed in practically all types of pulverized coal burners, with these seven important advantages:

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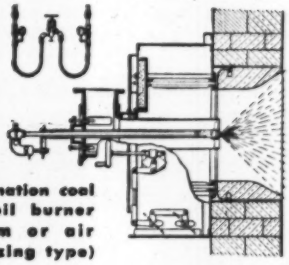
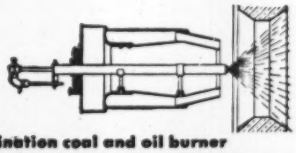
- They permit operation with oil or coal—whichever is available and lowest in cost per BTU.
- All capacities of steam, air or mechanical-atomizing types are interchangeable

The foregoing are only a few of the reasons why Enco oil-burners have been bought by a long list of leading industrial firms. Details of how Enco oil-burners can be adapted to your present pulverized coal burners will be gladly supplied—without obligation. Write The Engineer Company, 25 West St., New York, N. Y.



Combination coal and oil burner (Steam or air atomizing type)



Combination coal and oil burner (Mechanical atomizing type)

Enco Burners

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Full-scale output may be obtained from input signals in the 1 millivolt to 1 volt rms range.

Flat frequency response of the Linear-Integrating Amplifiers is as follows: Linear, ±5% from 5 to 5000 cps; Integrating, ±6% from 5 to 5000 cps (low range), and ±6% from 50 to 5000 cps (high range). Input signals for linear amplification may be as low as 3 mv, while those required for integrating operation are 190 mv (low range) and 19 mv (high range).

Sufficient power for the complete operation of as many as 12 amplifier channels is provided by the system's new oscillator-power supply. Excitation of pickups used with the system is accomplished through use of the oscillator section's 10 volt, 3 KC, 12 watt carrier output.

Bulletin CEC-1403 contains complete details, specifications, and prices, and may be obtained from Consolidated Engineering Corp., Pasadena 15, Cal.

Skew Roller Cooling Bed

A new type cooling bed which eliminates "cold spots" is in successful operation. The transfer rollers, which are the cooling surface proper of the cooling bed, are skew arranged. This gives the bars a combined lateral as well as longitudinal motion. This two-way motion eliminates "cold spots" by continuously changing the points of contact between the hot bars and the rollers. The cooling bed is a part of a complete steel mill installation designed and built by the Loewy Rolling Mill Division of Hydropress, Inc., 350 Fifth Ave., New York, N. Y.

Vaneaxial Blower

Direct-drive vaneaxial blowers, three types of belt-drive vaneaxial blowers and a special portable blower for exhausting fumes from tanks are described in a new bulletin issued by the Hartzell Propeller Fan Co., Piqua, Ohio.

The 16-page brochure includes dimension drawings and figures and complete air delivery tables for all of these blowers. Two of the belt-drive models, a high-temperature blower and a new design for low volume, high pressure requirements, are new lines which have not been shown in any previous catalog.

Copies of the new book, Bulletin A-110, may be secured by writing to the Hartzell Propeller Fan Co., Piqua, Ohio.

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NEW, two-volume reference work provides a wealth of material directly applicable to today's engineering problems—for mechanical engineers, aeronautical and chemical engineers, physicists, and applied mechanicians. Covering virtually every phase of compressible fluid mechanics, its scope ranges from fundamentals to analytical development of design methods and advanced exemplary methods. Discussions, based on clear physical reasoning, theoretical treatment, and empirical results, make this a work of high practical value. All important results are reduced to chart form; appendix contains numerical tables on compressible-flow functions to facilitate computations. *Vol. I (available now) 636 ills., 660 pp. Vol. II (ready Spring) 580 ills., 600 pp. $30 per set. $16 per volume.*

Professor Walton Forstall, Jr., of the Carnegie Institute of Technology writes: *"Shapiro has done a remarkable job. His book is notable for having all the virtues one would like to find in a work of this kind. It combines precision, clarity, orderly organization, logical development, valuable reference citation, and excellent problem material."*

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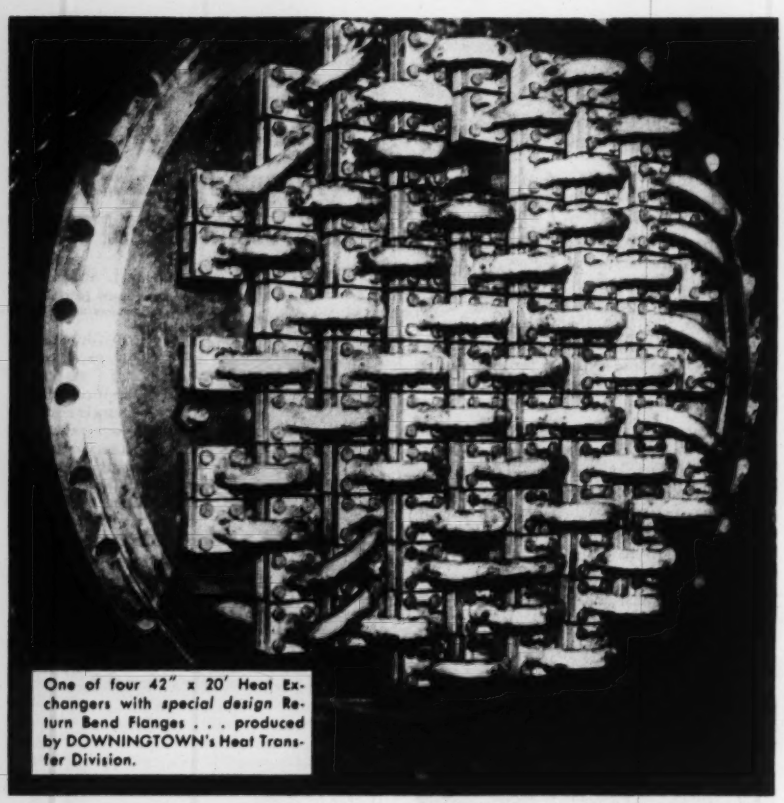

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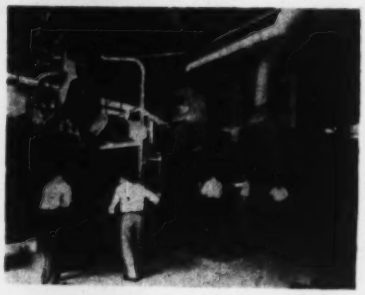

New Equipment for Blast Cleaning Demonstration Room

Several important additions have been made to the equipment installed in the Demonstration Room, located at the Hagerstown, Md. plant of Pangborn Corp., manufacturer of blast cleaning and dust collecting equipment.

This room was developed by Pangborn in order to solve blast cleaning and dust control problems in the shortest possible time, through the operation of full size equipment of all types. Production engineers from many of the largest industries in the world have come to Pangborn to seek help with their problems. Complete reports are submitted to any customer who sends samples to the Pangborn Demonstration Room for cleaning. Castings, forgings and heat treated parts have all been cleaned in the equipment on hand, to produce sample finishes. When a report is made it includes recommendations for the correct blast cleaning equipment, exact sizes and types of abrasives to be used, exact duration of blast time, and other important information.

Probably the best known new piece of equipment which has been added to the room is the Rotoblast Blastmaster Barrel, which has been developed by Pangborn for batch blasting of castings and is produced in sizes ranging from 3 to 27 cu ft capacity. Introduced only last year, this new barrel has been popular from the very start and has found wide application in industry.

Another machine just installed is a full sized steel sheet blasting machine capable of handling steel sheets up to 54 in. width which will clean in excess of 200 sq ft of surface per minute. Installations of this machine is a clear indication of increased interest in providing better finishes on steel sheets for product improvement by means of allowing the use of hot rolled instead of cold rolled steel, producing a better bond for paint adhesion, and the reduction of production costs by speeding and shortening time required to prepare sheets for fabrication. This machine, the ES-503 is equipped with two Rotoblast wheels which throw 120,000 lb of abrasives per hour. The machine was designed to take steel sheets into the blast cleaning chamber automatically, blast them clean and blow the abrasive off the sheet, before it is discharged from the machine.

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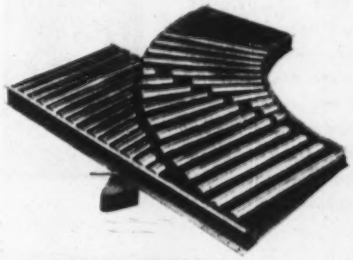
Other equipment operating in the Demonstration Room includes: 15-ton Rotoblast monorail installation, the type used in the automotive industry to clean as many as 240 engine cylinder blocks per hour; a miniature adaptation of Hydro-Finish, a liquid blasting process which is used on such delicate materials as wrist watch gears and hypodermic needles; a high production Continuous-Flo Rotoblast Barrel which is used for the continuous, production line blast cleaning of small castings; a large Rotoblast room for blast cleaning of large sized castings; a six ft Rotoblast Table-room, one of the most versatile of blast cleaning tools; a 9 ft LG Rotoblast Table, for a wide range of cleaning work; and a standard Hydro-Finish cabinet which is used to provide a smooth, matte finish on dies, molds, and precision equipment built to close tolerances. Also included in this Demonstration Room is the portable soft abrasive (corn cob) blast cleaning machine, which was developed by Pangborn to be utilized with compressed air and finely ground corn cobs to blast the dirt, rust, and grease from electric motors and mechanical equipment without damaging wiring, gears, and precision parts.

It is clear that this Demonstration Room is exactly what its name implies—a room properly equipped with machines to demonstrate to customers what blast cleaning can do. Pangborn also maintains a well equipped Physical Laboratory and Experimental Department where carefully planned research and testing programs are conducted.



Two-Directional Control in Package Handling

A new spur curve, developed by Mechanical Handling Systems, Inc., Detroit, embodies a switching mechanism which makes two-directional control of package or merchandise flow easy and positive. It may be manually or remote control operated; and the actuating mechanism may be solenoid, air ram or hydraulic ram, or manual.

The action of the new MHS switch is accomplished by moving each individual roller in the proper relationship to the direction of flow desired. This is done through an ingenious linkage system which moves the rollers into a positive position, guaranteeing the same position for each roller every time the switch is thrown.

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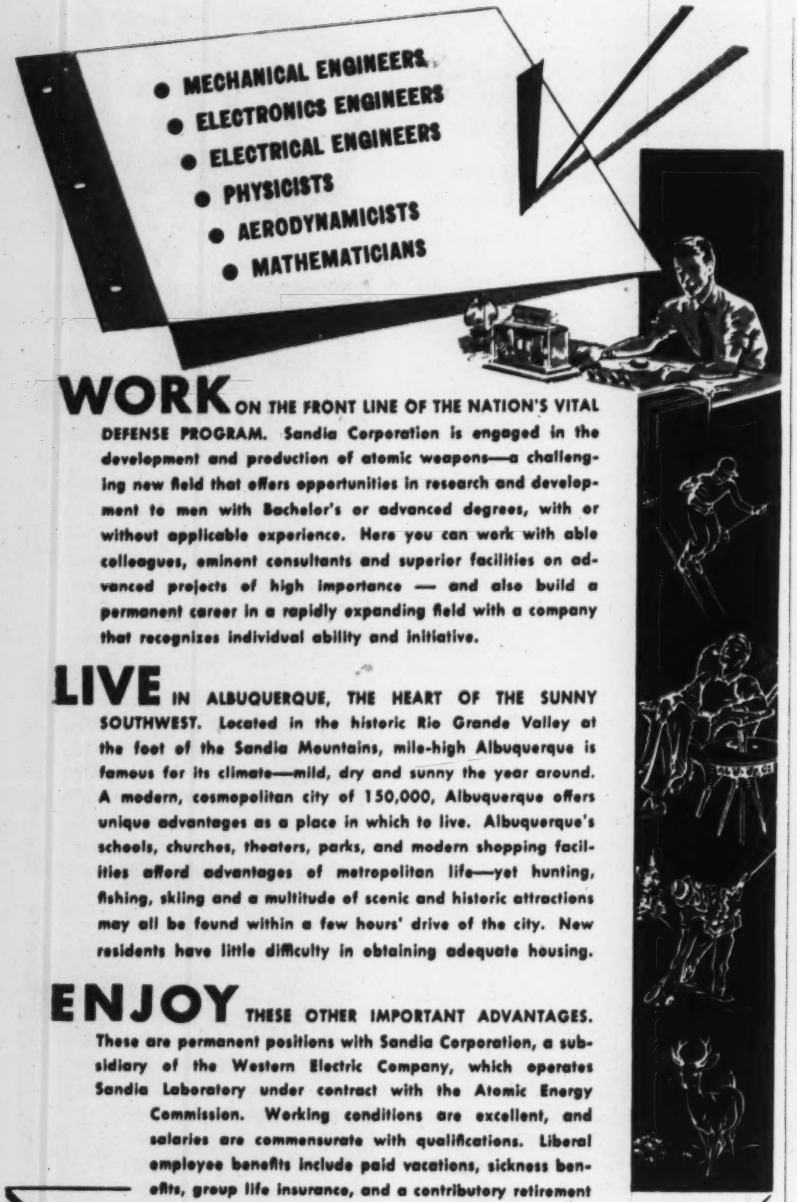

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ENJOY THESE OTHER IMPORTANT ADVANTAGES. These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates Sandia Laboratory under contract with the Atomic Energy Commission. Working conditions are excellent, and salaries are commensurate with qualifications. Liberal employee benefits include paid vacations, sickness benefits, group life insurance, and a contributory retirement plan. This is not a Civil Service appointment.

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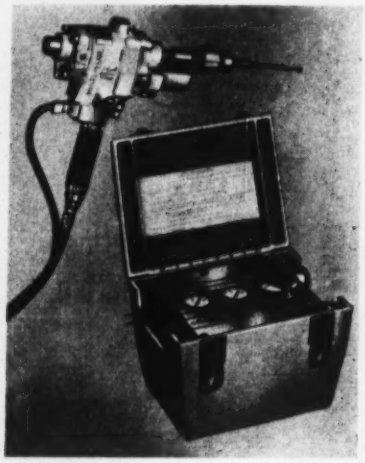
Switching rollers are cradled in individual brackets which are center pivoted and move on two ball supports. The ball supports are in turn cradled in nests of smaller balls to defeat friction and assure long life for the switch.

The new spur curve, with its ingenious switching mechanism, is available in various widths and weights of rollers from $1\frac{1}{4}$" to $2\frac{9}{16}$" diameter, and from 18 gage to 7 gauge. They are made in right and left 45° and 90° spur curves, and in Y switches with 45° and 90° changes in direction.

It may be used advantageously with roller, wheel, and belt conveyors, to handle crates, cartons, cans, drums, packages, bags.



Tube Rolling Control

Development of a new Electro-Pneumatic Tube Rolling Control that combines the advantages of air operation with precision electric control has been announced by Crane Packing Co. The new unit is equipped with an air motor which provides increased power and flexibility to give faster tube rolling and permit the use of only one motor for a wide range of tube sizes, both ferrous and non-ferrous. It is capable of rolling ferrous tubes up to $2\frac{1}{4}$" I.D., which makes it adaptable for use on many types of equipment. This includes condensers, heat exchangers, boilers, evaporators, coolers, dehydrators, etc.

Pneumatic-electric control insures perfectly controlled amount of tube expansion into the sheet so that tightness and holding strength are held to the exact amount required for the service. "Weepers" or "leakers" and the possibility of over-rolling are eliminated. "Cold work" crystallization is minimized to a negligible degree. Distortion or fracture of ligaments in the tube sheet is prevented. "Guess work" is eliminated and skilled operators are not required.

The Control is designed to handle three sizes of "John Crane" air motors: Size No. 1 for non-ferrous tubing up to $1\frac{1}{4}$" I.D.;

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Size No. 2 for nonferrous tubing up to $1^1/_2$" I.D., ferrous to $1^1/_4$" I.D.; Size No. 3 for ferrous tubing to $2^1/_4$" I.D. For further information contact Crane Packing Co., Dept. M15, 1800 Cuyler Ave., Chicago 13, Ill.

Black Granite Straight Edges

A new line of commercial accuracy black granite straight edges in lengths up to 72" has been developed to supplement the super precision straight edges by Collins Microflat Co.

Surfaces of these new straight edges are finished to an accuracy of 0.0002" per foot, whereas surfaces of Microflat super precision straight edges are finished down to 50 millionths overall. However, for the majority of commercial applications many shops do not require extreme accuracy and find that 0.0002" per foot adequate. These straight edges are more economical because less work is involved in producing and finishing them to 0.0002" per foot. They have the same advantages as the regular line of precision straight edges in that they are non-warping, non-deflecting, easily washable, incredibly smooth, temperature inert, rigid overall and moisture repellent.

The ends are tapered and fitted with leather grips for easy, secure handling. An attractive wooden leatherette-covered carrying case, richly felt lined, can be provided at a small additional charge.

A bulletin describing the commercial accuracy straight edge may be obtained from Collins Microflat Co., 2326 E. 8th Street, Los Angeles, Cal.

Heavy-Duty Crane Scale

John Chatillon & Sons, 85 Cliff St., New York 38, N. Y. announces the marketing of its newest heavy-duty dynamometer Crane Scale—Model No. 16-10,000DH—designed to withstand the rough service which would ruin other types of weighing apparatus.

The capacity of this spring-type scale is 10,000 lb. calibrated in increments of 25 lb. Readings are made directly from the 15 in. diameter aluminum dial. The dial is recessed and covered with plexiglass for added protection to both dial and pointer.

Of particular interest is a new 10 per cent tare adjustment feature and ball bearing swivel hook to shorten overall length. Overall length is 36.5 in. and extension at capacity is only 1.208 in.

Roth Rubber Solves Rubber Problem for West Coast Manufacturer!

A viewing hood for an oscilloscope seems like a simple problem for the rubber technologist, yet it is significant that Tektronix, Inc., of Portland, had Roth Rubber, in Chicago, provide the solution. The viewing hood must not crack or buckle, has to adjust to any face and must exactly fit the Tektronix scope. Roth engineers solved this problem—they can solve *yours*.

Engineers and Rubber Buyers!

Write for your free Roth Rubber Sampler. This unusual kit contains actual rubber samples with hardness from 5 to 100 Durometer . . . gives ASTM specs and lists uses for each sample. Sorry, but offer must be limited to engineers and rubber buyers only. Please ask for Roth Rubber Sampler No. ME2.

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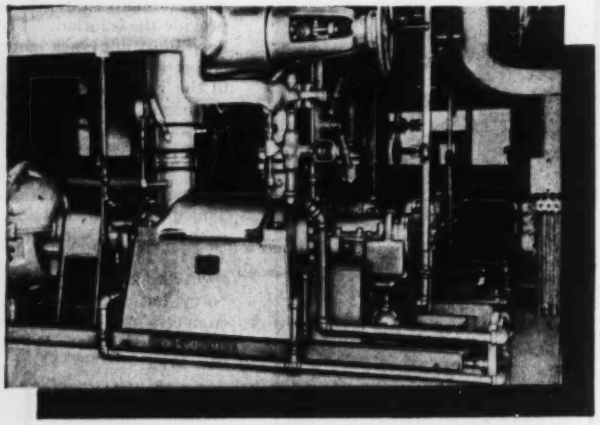
Sizes installed range from the midgets of less than 50,000 lbs. per hour to the giants having a capacity of 1,000,000 lbs. per hour. The operating discharge pressures range from 200 to 2500 psig. More than 50 units are operating at discharge pressures above 2000 psig.



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BF-18

New Dry-Process Photocopying Materials

A new line of dry-process photocopying papers which give exceptionally clear, sharp copies of a wide range of original material has just been introduced by the Dri-Stat Division, of Peerless Photo Products, Inc., Shoreham, Long Island, N. Y.

These new papers and the single processing solution for use with them produce prints with good blacks and an extremely clear white background in striking contrast. In some cases the copy is actually an improvement over the original in legibility and clarity. These results, Peerless explains, are due to the careful balancing of the emulsions on the No. 1 and No. 2 papers and the processing solution. Materials have been selected so as to give the user of papers a much greater leeway in the range of original matter that can be photocopied.

Anything that is legible on the original—penciled notations, colored ink or crayon markings, stenciled or spirit-process duplicated copy—will be readable on the Dri-Stat copy, Peerless claims. This makes the Dri-Stat process suitable for reproducing such a variety of material as letters, design sketches, advertising layouts, bank statements, ledger sheets, payroll records, insurance claim papers, birth certificates, business paper inquiries, reports, manuscripts, medical transcripts, clippings from periodicals, purchase orders, invoices, and bills of lading.

The new papers and processing solution were developed especially for use in Peerless' own line of transfer-process photocopying equipment recently introduced. They can also be used, however, with equally good results of most other makes of dry-process copying equipment now on the market.

No. 1 paper is a high quality paper, uniformly coated with an emulsion of high silver content, which affords the user a generous margin of safety in selecting exposure time. No. 2 paper is available in three different types: Standard (a 100 gram paper .005 in. thick, made of Alpha sulphite fiber) for general office use; Thin (a 55 gram white rag vellum paper .003 in. thick) for airmail use and filing, and as an intermediate in the making of blueprints and diazo prints; and Duplex (same weight as Standard but coated on both sides) useful for salesmen's manuals, instruction books, and the like.

The new photocopying materials will be sold through the nationwide network of Peerless distributors, all of whom are photocopy specialists and maintain complete stocks and facilities for quick service.

For further information, write to Dri-Stat Div., Peerless Photo Products, Inc., Shoreham, L. I., N. Y.

For Consulting Engineers

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LATEST CATALOGS

New Internal Comparator

The Portage Double Quick Tool Co., 1076 Sweitzer Avenue, Akron, Ohio, announces the new "Interapid" Internal Comparator. This gage is used for internal measuring, such as inside diameters. The gage has capacity for gaging diameters from 3/8" to 6". The adjustment of the instrument is made by turning the knob in the center of the gage.

The initial setting of the gage is made with gage blocks, master gage rings or micrometers. A small locking lever (top center of photograph) is provided for retracting the arms to make it easier for the gaging tips to enter the work being checked. The comparative reading on the meter-type scale shows at a glance whether the holes are over or undersize and by exactly how much. The meter-type scale is graduated in .0005". The measuring tips being at the extreme end of the arms makes it possible to check the diameter of very shallow counterbores. (Minimum depth 1/16")

The set includes two sizes of centering arms which snap on and off readily. The centering arms are used in checking larger diameters. They provide a three point contact on one arm which eliminates "hunting" for the center of the bore.

The Gage is designed for use on Jig Borers, Boring Machines, Internal Grinders, Lathes and for all inspection personnel.

Depressed Center Grinding Wheels

The Carborundum Co., Niagara Falls, N. Y., announces the availability of its new Carboflex depressed center grinding wheels for rough grinding, weld removal, cut-off and slotting operations for ferrous and nonferrous metals and nonmetallics.

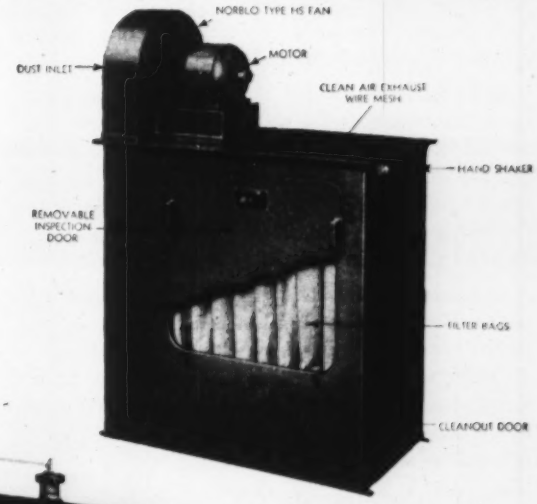
Combining aggressive cutting action with extreme high strength and resistance to cracking, the new glass-fiber-reinforced resin bond wheels provide efficient operation with maximum safety.

Extensively field tested in foundries, steel mills and all types of metal working and

Keep workroom air clean—
protect work and workers with

Norblo

Portable bag-type Dust Collectors



Many plants can be effectively and profitably equipped with Norblo Portable and Semi-Portable Dust Collection Units, to remove unhealthful and sometimes dangerous contaminants from dust-producing machines. Localized dust control for grinding, polishing, sawing and other operations is thus provided at much lower cost than with a large centralized system.

Norblo Portables occupy small space, can be elevated to save floor area. And they're easily moved if re-location of machines proves desirable. Units are available in various arrangements for dust clean-out. Six sizes range from 300 to 1350 C.F.M., operate at 8" static pressure at the fan. Also larger sizes—semi-portable. Write for Bulletin 163-5.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

6421 Barberton Ave. OLympic 1-1300 Cleveland 2, Ohio

Are you one of a select group of aerodynamicists sincerely interested in boundary layer control projects? The Aircraft Division of Fairchild offers a genuine creative opportunity to such men.

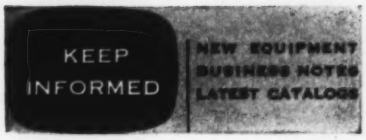
Reconnaisance aircraft . . . jet fighters . . . jet bombers and transports . . . as well as engineering advances on the world-renowned C-119 Flying Boxcar and soon-to-be-produced C-123 Assault Transport are coming from Fairchild. Diversified, stimulating assignments like these increase the inventive challenge to Fairchild's team of qualified aerodynamicists.

Gracious country living only minutes away from urban Baltimore or Washington . . . paid pension plan . . . an excellent salary with paid vacations . . . an ideal working environment . . . generous health, hospitalization and life insurance . . . and the many other benefits of a progressive company add to the pleasure of working with Fairchild.

You'll be investing wisely in a secure future if you take time today to write to Walter Tydon, Chief Engineer, outlining your qualifications. Your correspondence will be kept in complete confidence, of course.

☆ **BOUNDARY LAYER CONTROL**

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Aircraft Division
HAGERSTOWN, MARYLAND



metal fabricating industries, Carboflex depressed center wheels show all-round versatility.

Typical foundry applications include roughing-off fins and sharp edges, notching and cutting-off gates and risers, and removing burned sand and cleaning castings.

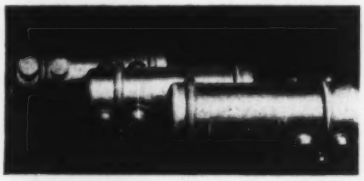
In steel mills and fabrication plants—including weld shops, shipyards, railroad shops, ordnance and automotive plants—the new wheels find extensive use in weld preparation and weld removal, general purpose roughing and surface grinding, cut-off and slotting.

Carboflex depressed center wheels are also used for grinding nonmetallics; for example, removing flash on low pressure laminate moldings, car bodies, boats, etc.

Designed with a knurled back in addition to the knurled face, the new wheels enable the operator to cut with both sides and the periphery of the wheel without any initial dressing.

The new wheels come in sizes of 7 and $9^1/_8$ in. in diameter; $^1/_8$, $^3/_{16}$ and $^1/_4$ in. in thickness and contain a $^7/_8$ in. arbor. Grading A24-R-BC is recommended for metal applications, and grading C24-R-BC is used for nonmetallics.

The Carboflex wheels are being merchandised by Carborundum's Bonded Products and Grain Div.



Corrosion-Resistant Aluminum Heat Exchangers

Aluminum heat exchangers constructed for Solvay Process Division, Allied Chemical & Dye Corp. All-aluminum construction was specified for these units in order to resist corrosive action of hot ammoniacal process liquors. Exchangers were constructed by Downingtown Iron Works; materials specifications jointly worked out by Aluminum Co. of America and Solvay Process Division, Pittsburgh, Pa.

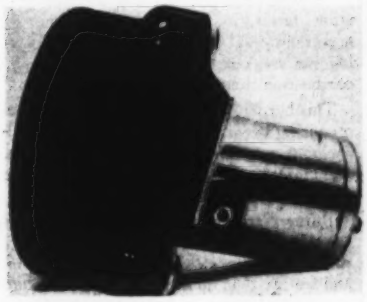
Dual-Fuel Burner

The North American Mfg. Co. has filled a gap in its line of Series 212 Dual-Fuel Burners by adding recently the 212-5 size ($2^1/_2$ inches air connection). Like all Series 212 burners, the 212-5 is a rugged burner which will withstand abuse, making it a "natural" for use on forge furnaces. It also finds application on melting pots, driers, and kilns.

Series 212 burners may be operated on heavy oil, light oil, or gas; with either manual or automatic control. Low pressure air is used for oil atomization; the pressure requirements at the burner being 22 osi for heavy oil and 14 osi for distillate oil.

Capacity of the 212-5, when operating on gas with combustion air pressure of 16 osi at the burner, is 925,000 Btu per hr. Capacity when operating on oil is increased to 1,200,000 or 1,350,000 Btu per hr. because of the additional air supplied for oil atomization. The 212-5 has good turndown, since even on heavy oil it can operate on atomizing air only without forming carbon.

For further information write to North American Mfg. Co., 4455 East 71st St., Cleveland 5, Ohio, and ask for Sheet DF-212-3.



D-C Motor Centrifugal Blower

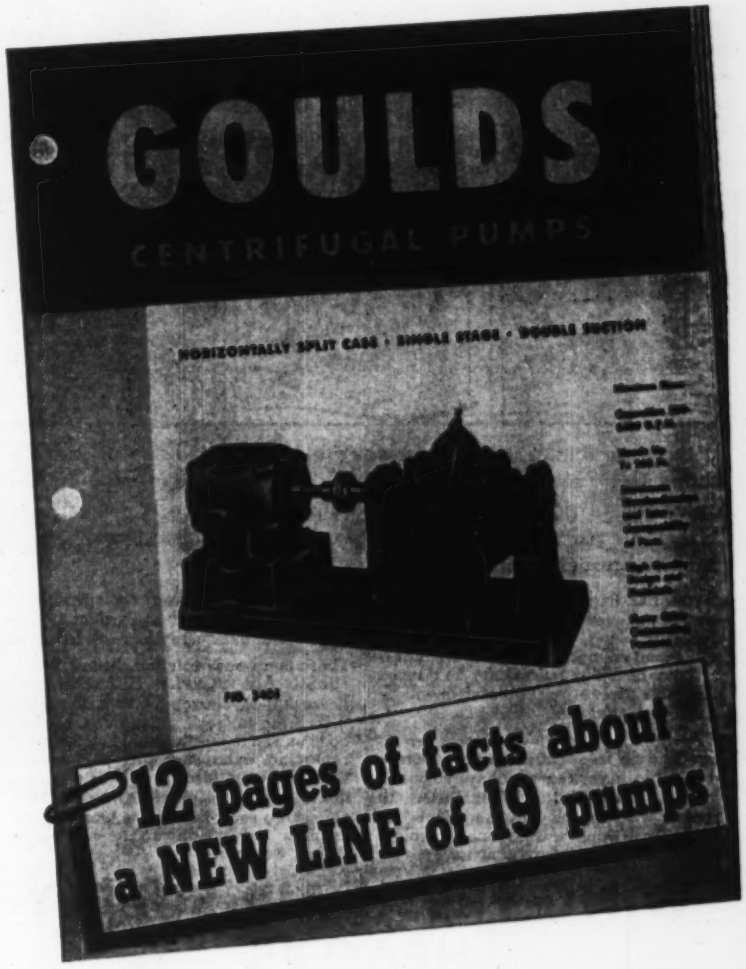
Mission-Western Engineers, Inc., of Pasadena, Cal., an affiliate of Western Gear Works, announces a new permanent magnet d-c motor and centrifugal blower. This miniature blower weighs just $7\frac{1}{2}$ ounces and has an air volume of 20 CFM in free air. It measures approximately $2\frac{7}{8}$ in. at the blower end while the motor is $1\frac{1}{4}$ in. in diameter. Address inquiries to Fred J. Andrew, Mission-Western Engineers, Inc., 132 West Colorado Blvd., Pasadena 1, Cal.

Water Demineralizer

The Barnstead Still & Sterilizer Co., 145 Lanesville Terrace, Boston 31, Mass., announces a new line of Mixed Bed Water Demineralizers featuring the latest engineering developments in the ion-exchange process of water purification. Included is an improved system for regeneration of the purifying resins after they have become exhausted. Capacities run from a range of 50 to 2,500 gallons of mineral-free water per hour.

Impurities such as sodium, calcium, potassium, magnesium, iron, copper, chlorides, sulfates, bicarbonates, carbonates, etc. are eliminated. Even silica, carbon dioxide, and other weakly ionizable impurities are removed. This effective ion removal results in an effluent water of very high electrical resistance, often up to 20,000,000 ohms per C.C.—and invariably higher than can be obtained with other types of demineralizers.

Literature and engineering recommendations will be gladly sent without cost or obligation. Write to: Barnstead Still & Sterilizer Co., 145 Lanesville Terrace, Forest Hills, Boston 31, Mass.


GOULDS
CENTRIFUGAL PUMPS
HORIZONTALLY SPLIT CASE • SINGLE STAGE • DOUBLE SUCTION
12 pages of facts about
a NEW LINE of 19 pumps

The quickest way you can really discover what the new Goulds Fig. 3405 centrifugal pump can do for you is to read the descriptive bulletin pictured above.

Here are some hints of what you'll find:

The quality of materials and extras of design that you have been able to get only by paying extra are *standard* on this new pump: stuffing box bushings, stainless steel impeller keys, Teflon water seal rings —to mention a few.

The Fig. 3405 carries interchangeability of parts far beyond anything we've been able to do before. Only three shaft and rotating parts assemblies (exclusive of impellers and wearing rings) provide for 19 pump sizes.

This means real spare parts inventory savings for any plant that uses many pumps. It also means easy-to-make field changes to meet new requirements.

We've come as close as modern design and materials allow to putting into this new pump what our industrial customers have told us they want. The 12-page illustrated bulletin tells you all about it. We'll be glad to send you a copy.

To get a copy of Bulletin 721.6, get in touch with the nearest Goulds representative or just fill in the coupon, pin it to your letterhead and mail it to us at your convenience.

GOULDS PUMPS, INC.
Dept. ME, Seneca Falls, N. Y.
Please send me 12-page information Bulletin No. 721.6 on the new Fig. 3405 centrifugal pump.

Name_____
Company_____
Street_____
City_____ Zone____ State____

Is Your Factory Starved for AIR?

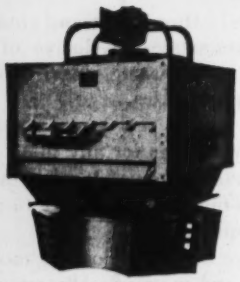
If this is what happens when you go from the office out into the shop, your plant is starved for air! The vacuum created by the operation of necessary exhaust equipment is usually responsible. While our pictures may be slightly overdrawn, something like that may be happening in your plant.

If your building is not new, the vacuum may be relieved by crevices, loose-fitting doors, windows, and open doors which will admit so much unheated air that a great deal of discomfort may be caused and your present heating system will be entirely inadequate.

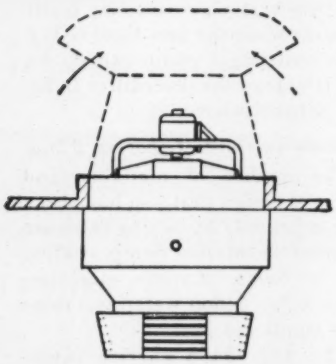
If the building is tight—no excess crackage and no frequently opening doors—the ventilating system which you so painstakingly designed and installed to protect your employees and increase production won't work properly, unless you make special provisions for delivering into the building an amount of warmed air at least equivalent to that which your exhaust system will take out.

There is an easy solution. Install WING FRESH AIR SUPPLY HEATERS with Revolving Discharge Outlets. In winter they bring in fresh air through heating coils varied to just the right temperature, replacing exhausted air. In summer, with the steam turned off, they circulate the air in your plant, giving a cool, refreshing sensation to the workers and keeping production up to normal in stifling weather.

WING FRESH AIR SUPPLY HEATERS



WING Fresh Air Supply Unit with fan enclosed in casing.



(Right) WING Fresh Air Supply Unit with fan above roof line.

Wing

L. J. Wing Mfg. Co. Linden, N.J.
156 Vreeland Mills Road

Factories: Linden, N.J. & Montreal, Canada
In Europe: Etab. Wanson, Brussels, Belgium

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Commercial Oil Burner

A new heavy-duty pressure atomizing commercial oil burner has just been announced by the Iron Fireman Mfg. Co., Cleveland 11, Ohio. This new burner, known as Model C-1-A, for firing CS No. 2 or lighter fuel, is available in capacities ranging from 4 to 8 gallons per hr.

The burner is built around a rugged cast iron fan housing with convenient external adjustments provided for the atomizing nozzle position and position of the air diffuser assembly. This permits adjustments to be made while the burner is in actual operation, facilitating setting of the burner for maximum combustion efficiency and allowing the most suitable flame shape for the combustion chamber.

This burner, like all Iron Fireman pressure atomizing burners, is equipped with a totally enclosed, permanently lubricated, ball bearing motor produced by the Iron Fireman Mfg. Company's Electronics Div.

Burners are available for use either with stack switch or electronic controls in draft-tube lengths of 9 in., 16 in., or 22 in., and feature twin nozzles for improved atomization.

Permanent Ceramic Magnet

A completely new type of magnet, composed of ceramic material which is lighter in weight than metal and requires no critical ingredients, was announced today by The Indiana Steel Products Co. of Valparaiso, Ind., producer of permanent magnets.

The new permanent magnet, called Indox, is expected to open new fields for use of magnets in industry and in consumer items.

Although Indox is composed of materials which are "earthy" in nature and are non-organic and non-metallic, it is magnetized in the same manner as metals. The magnitude of the magnetizing force required, however, is more than three times that necessary for Alnico, the metallic permanent magnet in common use today.

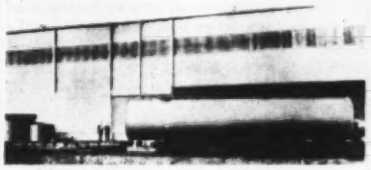
In addition to being lighter than Alnico, and requiring no critical materials, Indox has twice as much coercive force as Alnico and is a non-conductor, Smith said. And, he added, it is virtually impossible to demagnetize the Indox material by any ordinary means.

Indox is made from non-critical materials, iron oxide and barium carbonate, and goes through a number of critical cycles in powder preparation, pressing in dies and heat treatment. It was developed in the research laboratories of N. V. Gloeilampenfabrieken at Eindhoven, Holland. It is the first new magnetic substance since the development of Alnico in 1931. The Alnico magnets currently being produced by Indiana Steel have more than 35,000 applications.

Indox has a coercive force of approximately 1,600 oersteds and an intrinsic coercive force of approximately 4,000 oersteds.

It can withstand demagnetizing fields above 2,000 oersteds without large loss of magnetic flux.

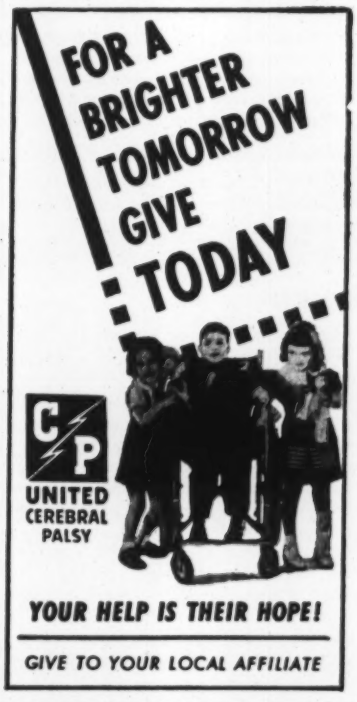
The Indiana Steel Products Co. has constructed a new addition to its plant in Valparaiso for the production of Indox. Special new equipment is to be installed in the building and commercial production of the new magnet is expected to begin.

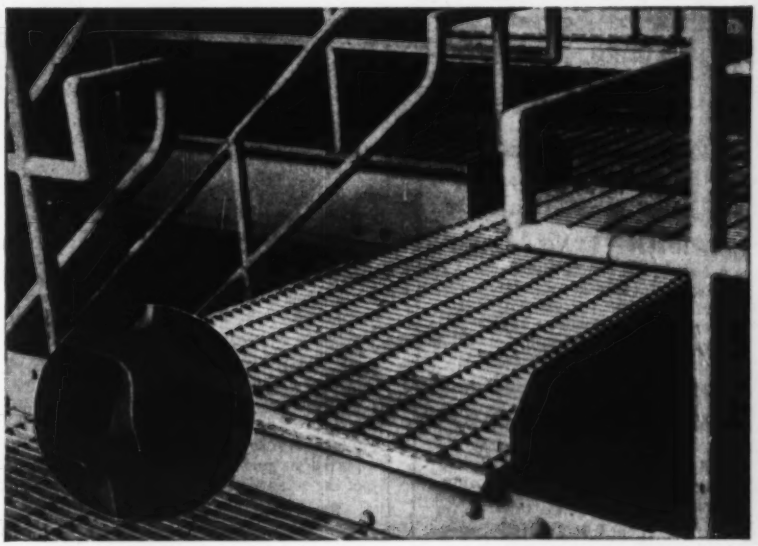


The World's Largest Silencer

As noise grows, so grow silencers. Here is what is believed to be the largest Silencer ever built. It measures 74 feet long by 12 feet in diameter, and has an estimated weight of 70,000 lb.

This one was designed to silence the exhaust of a 5,000 KW Simple Cycle Gas Turbine Generating Unit installed at a midwestern Utilities company. It was designed and built by the Burgess-Manning Co. of Libertyville, Ill. specialists in silencing of intake and exhaust noises from steam exhausters and ejectors, internal combustion engines, compressors, blowers, vacuum pumps, etc. Many of the silencers designed by Burgess-Manning incorporate important additional functions such as: spark arresting, air cleaning, heat recovery and surge control.





Grating by BLAW-KNOX

where do **you** need **steel grating?**

There must be lots of places where you are now using grating—floors, platforms, walkways, catwalks and stair treads, for example.

But how about other uses—such as some sturdy shelving or a fan guard—or for covering a dangerous open pit or a light well. Take a good look around your plant and you'll probably come up with several jobs, including perhaps a new use, as steel grating is adaptable to many applications.

Any time you want some help on a job related to grating, we'll be glad to hear from you.

Only BLAW-KNOX Electroforged® Steel Grating and Stair Treads —have these five exclusive features:

1. **rigid one-piece construction—easy to install**
2. **all surfaces accessible—easy to paint**
3. **no sharp corners to clog—self-cleaning**
4. **maximum open area—for light and ventilation**
5. **non-slip twisted crossbar—safe footing**

A short note will bring you a copy of new Bulletin No. 2365-R —a dimensional sketch will bring you a quotation.

BLAW-KNOX

BLAW-KNOX COMPANY
2105 Farmers Bank Building • Pittsburgh 22, Pennsylvania

BLAW-KNOX EQUIPMENT DIVISION
GRATING DEPARTMENT

GRATING APPLICATIONS: floors • platforms • walkways • catwalks • stair treads • fan guards • shelving • and many other uses, both outdoors and indoors, for versatile steel grating.

Sound Films you can use without cost!

SEE how others cut production costs

"MULTIPRESS—Blanking & Forming"

A 10-minute, 16mm sound film . . . close-ups of several production jobs *including the fastest hydraulic press operation you've ever seen!* Ideal for ASME meetings, student groups, production clinics!

Other 16mm Sound Films

"MULTIPRESS—and how you can use it"

30 minutes of Multipress action on broaching, trimming, forming, marking, crimping, assembling, staking and pressing jobs.

"INDEX to Profits"

A 20-minute film showing how Multipress ends lost time and motion with a space-saving 13-step assembly line for 34-piece auto door latches.

Write Denison, or the Denison representative in your area, about the films you'd like to use—and when. *No obligation whatever.*

The DENISON Engineering Co.

1189-A Dublin Rd., Columbus 16, Ohio

Vibrating Conveyors and Screens

The Syntron Company, 498 Lexington Ave., Homer City, Pa. announces an entirely new, complete line of "Balanced, Dual Trough" vibrating conveyors and screens, for the conveying or screening, or conveying and screening and distributing of bulk materials, hot or cold, dry or damp, abrasive or corrosive—from fine powders to big chunks.

They are of the compulsory driven, swinging mass type in which two troughs or screens, mounted one above the other are connected by leaf springs and the whole assembly supported on guide links, follow the movement of the eccentric drive.

The Vibrating Conveyors, which can also be fitted with screen sections, are available in two capacities. The Model "2-B" with a maximum capacity of 80 tons per hour is available in sections up to 65 feet long with a trough width of 20 in.—and in sections up to 30 ft long in 40 in. trough widths. The Model 6-F, with a maximum capacity of 280 tons per hour is available in sections up to 175 feet in the 20 in. wide trough and up to 100 ft in the 40 in. width. Sections can be set in to any desired length.

Descriptive literature, complete with specifications is available.

Complete Range of Space Heaters

With the addition during 1953 of a gas-fired unit and an oil-fired space heater to its line of warm air heaters, the Heating Dept. of the Machinery Div. of Dravo Corporation, Pittsburg 22, Pa. now has available a complete range of equipment ranging in capacity from 68,000 to 2,000,000 Btu per hr.

Distribution of Dravo heaters, extensively used for industrial and commercial applications, was broadened last year by the addition of several new sales representatives in the U. S. License agreements were negotiated with foreign companies for the manufacture and sale of Dravo Heaters in other parts of the world.

Among the larger installations of Dravo heaters made during 1953 were 60 at the Pittsburgh Steel Company's Allenport, Pa. plant; 30 at Libby, McNeil & Libby's 10-acre central warehouse in Hammond, Ind.; and seven for Ford Motor Company's West Mifflin, Pa. plant. The latter makes a total of 18 Ford depots throughout the U. S. now equipped with Dravo heaters.

Development in Steam Measurement

Builders-Providence, Inc., 345 Harris Ave., Providence, R. I., in conjunction with the C. E. Squires Company of Cleveland, Ohio, has recently developed an engineered equipment package that makes possible the measurement of steam under widely different load conditions. The principle involved is the division of flow from a high range to a low range Shuntflo meter, whenever the demand on the system is low, by means of a compact changeover arrangement. The following advantages are cited: provides means for metering over a much wider range than any single step meter; increases annual revenue; prevents overload and subsequent damage to low range meter; eliminates need for condensate meter with return lines and attendant maintenance problems; eliminates need for changing meter capacities (orifices). Application Memo no. K19 is available upon request.

Borescopes

American Cystoscope Makers, Inc., 1241 Lafayette Ave., New York 59, N. Y. present information on various types of Borescopes.

The borescope is a precision optical instrument for the visual inspection of a wide variety of internal surfaces such as bores, deep holes, recesses and other inaccessible areas. It permits visualization of hidden internal surfaces in small, intricate parts through openings as small as .120 in., or inspection of large internal surfaces such as tubular heat exchangers through openings four inches in diameter and to depths of sixty feet.

ACMI Borescopes have been applied to a wide variety of industrial inspection problems and have proved useful in such

for better gears . . .

CAREFULLY CONTROLLED HEAT TREATING

To more efficiently produce the specially heat treated custom gears for which we've become famous, we have complete heat treating facilities adjacent to our modern gear manufacturing plant. Because of the close production and quality control made possible by our integrated facilities, we can produce the *best* in special heat treated custom gears, and produce them economically. Next time you need heat treated gears, remember The Cincinnati Gear Company does the whole job—and does it right!

SPUR
WORM
INTERNAL
SPIRAL BEVEL
HELICAL
HERRINGBONE
*CONFLEX BEVEL
SPLINE SHAFT

*Reg. U. S. Pat. Off.

THE CINCINNATI GEAR COMPANY

"Gears . . . Good Gears Only"

Wooster Pike and Marlemont Ave. • Cincinnati 27, Ohio

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

diverse applications as examination of aircraft engines through spark plug openings, aircraft propellers, machines and machined components, foundry castings, chemical process equipment, tools and fixtures, atomic energy installations and many other applications. The optical systems are designed to provide forward, foroblique, right angle or retrospective visual fields. All of the lens systems are non-reflection coated to provide maximum transmission of light and brilliant, distortion-free images.

BUSINESS NOTES

Carboloy Department to Expand

An expansion program of over $1,000,000 to be completed late in 1954 was announced by Carboloy Dept. of General Electric Co., Detroit, Mich.

The program includes the addition of 36,000 square feet of floor space to the Department's metals building on East 8-mile road in Detroit, plus new engineering and manufacturing equipment. Construction is expected to start Feb. 1.

Falk Announces New Sales Office

The Falk Corp., 3001 West Canal, Milwaukee 8, Wis., announces the opening of a new sales office in Dayton, Ohio, as a branch of the Cincinnati District Office. Howard H. Nuernberg has been appointed as Sales Representative in this new office under the supervision of K. W. Morrissey, Cincinnati District Manager. The new Dayton Office will be located at 410 W. First St.

The Midwest Fulton Co., which formerly represented Falk in the Dayton area, will continue as an authorized Falk Coupling Distributor.

Pangborn Golden Anniversary Year

The year 1954 will mark the celebration of the Golden Anniversary of Pangborn Corp., Hagerstown, Md., manufacturer of blast cleaning and dust control equipment.

Thomas W. Pangborn, President, sold his first sand blast machine in New York City in 1904. John C. Pangborn joined his brother in the following year. Growth was rapid and a plant was established in Jersey City in 1909. These facilities were outgrown in 1912, at which time the business moved to Hagerstown.

Pangborn's facilities in Hagerstown include foundry, plate, sheet metal and machine shops, assembly plants, paint and woodworking shops. A beautiful public park, a gift of the Pangborn brothers to the city, is located adjacent to the plant.

A series of events are being planned to celebrate the Golden Anniversary Year culminating on Sept. 1, 1954, the official birthday of the firm.

Engineering, production and economic advantages obtainable with closed die forgings are presented in this Reference Book on Forgings. Write for a copy.

combining strength with unmatched toughness, are indispensable to the operation of all types of aircraft

. . . especially those types that are used for the defense of our country. A product fortified with the metal quality found in forgings outperforms other products. Forgings are used for the toughest work loads. Check all the parts, particularly those which are subject to greatest stress, that make up your product. Check these parts with the aid of Problem Parts Attack Charts which are available upon request. These charts reveal the unrivaled economic and mechanical advantages of closed die forgings and relate them to specific engineering and production problems. Then consult a Forging Engineer about the correct combination of mechanical properties which closed die forgings can provide for your product.

DROP FORGING ASSOCIATION

605 HANNA BLDG. • CLEVELAND 15, OHIO

Please send 64-page booklet entitled "Metal Quality—How Hot Working Improves Properties of Metal", 1953 Edition.

Name .....

Position .....

Company .....

Address .....

NATIONAL AIROIL

Oil Burners

OF THE STEAM AND MECHANICAL TYPES NOW COMBINED INTO

Dual Stage BURNERS

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one new NATIONAL AIROIL Dual Stage Burner.

41 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel oil from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed description, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

OIL BURNERS and GAS BURNERS for industrial power, process and heating purposes
STEAM ATOMIZING OIL BURNERS
SLUDGE BURNERS, Steam Atomizing
MOTOR-DRIVEN ROTARY OIL BURNER
MECHANICAL PRESSURE ATOMIZING OIL BURNERS
DUAL STAGE, combining Steam and Mechanical Atomization
LOW AIR PRESSURE OIL BURNERS
AUTOMATIC OIL BURNERS for small process furnaces and heating plants
GAS BURNERS
COMBINATION GAS & OIL BURNERS
FUEL OIL PUMPING and HEATING UNITS
FURNACE RELIEF DOORS
AIR INTAKE DOORS
OBSERVATION PORTS
SPECIAL REFRACTORY SHAPES

NATIONAL AIROIL BURNER CO., INC.
1239 E. Sedgley Ave., Philadelphia 34, Pa.
Southwestern Div.: 2512 So. Blvd., Houston 6, Texas

KEEP INFORMED — NEW EQUIPMENT, BUSINESS NOTES, LATEST CATALOGS

Boston District Office Moves to Larger Quarters

The Boston District Office of Bailey Meter Co., Cleveland, Ohio, manufacturers of industrial instruments and automatic control equipment—has moved to new quarters at 230 Congress St., Boston 10, Mass.

Under the managership of P. T. Reuter, the Boston Office is staffed by Instrument Engineers K. T. Bridgman, C. B. Callahan, H. T. Griffin, C. M. Holden, F. M. Sargent, Henry Thistle, R. C. Van Der Voort, and G. D. Williams.

The Boston territory, serving power and process plants, includes Rhode Island, Massachusetts, Vermont, Maine, New Hampshire, and Connecticut.

Westinghouse Expands Mansfield, Ohio, Appliance Plant

More than 2½ million dollars will be spent during 1954 to rearrange and expand the Westinghouse Electric Appliance Div. plant in Mansfield, Ohio. This is the first step in a program to approximately double production of several major appliances and substantially increase production portable appliances.

Specifically, the greater portions of the new equipment being purchased for the Mansfield plant will be for the expansion of the following operations: (1) increased production of Corox heating units (used in many major and portable appliances); (2) an additional paint oven; (3) expanded thermostat manufacturing facilities; (4) additional mechanical presses; and (5) expanded fabricating facilities for major appliances.

Shell Chemical Forms Ammonia Division

Shell Chemical Corp. 50th West 50th St., New York 20, N. Y. has formed an ammonia division effective January 1, to handle the manufacture, distribution and sale of this chemical vital to agriculture and industry.

Headquarters of the new division will be San Francisco. Its formation follows the opening December 11 of the new Shell Chemical ammonia plant at Ventura, Cal., largest producer of anhydrous ammonia and ammonium sulphate west of the Rockies.

G. R. Monkhouse, vice president of the company, has been appointed to head the new division. L. M. Roberts, general manager of manufacturing in the company's New York headquarters, will go to San Francisco as the new division's operations manager in charge of manufacturing, distribution, and marketing engineering.

In addition to their new duties in the ammonia division, Monkhouse and Irvine will continue as manager and sales manager, respectively, of Shell Chemical's western division which handles sales of all other Shell Chemical products.

But why MEN over 45?

Our doctors still don't know *why*, but if you are a man over 45 you are six times as likely to develop lung cancer as a man of your age twenty years ago. They *do* know, however, that their chances of saving your life could be about *ten times* greater if they could only detect cancer long before you yourself notice any symptom. (Only 1 in every 20 lung cancers is being cured today, largely because most cases progress too far before detected.)

That's why we urge that you make a habit of having your chest X-rayed every six months, no matter how well you may *feel*. The alarming increase of lung cancer in men over 45 more than justifies such precautions. Far too many men die *needlessly!*

Our new film "The Warning Shadow" will tell you what every man should know about lung cancer. To find where and when you can see this film, and to get life-saving facts about other forms of cancer, phone the American Cancer Society office nearest you or simply write to "Cancer"—in care of your local Post Office.

American Cancer Society

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Transfers to New Office

Taylor Dynamometer & Machine Co. manufacturers of "Hi-Eff" equipment, have transferred their general office and research-development dept. to a new building, recently completed by the firm at 6411 River Parkway, Milwaukee, Wis.

Under the "Hi-Eff" trade name, the Taylor Company manufactures a line of static balancing machines, dynamometers, and high-speed sensitive small-hole drilling machines. Their equipment is widely used wherever both mass production and high accuracy are involved.

Moves New York Branch Office

To meet expanding business needs and provide better service, The H. M. Harper Co., Morton Grove, Ill. has moved its New York City operation to a newly-constructed, 15,000-square-foot building at 225 Hoyt Ave., Mamaroneck, N. Y.

The new branch office and warehouse will carry complete stocks of the more than 7,000 different bolts, nuts, screws, washers, rivets and other corrosion-resistant fastenings produced by this company. In addition, a special service department has been added, and is equipped with slotting, threading, cutting and other equipment to handle small rush orders that require special handling.

Expands Manufacturing Facilities

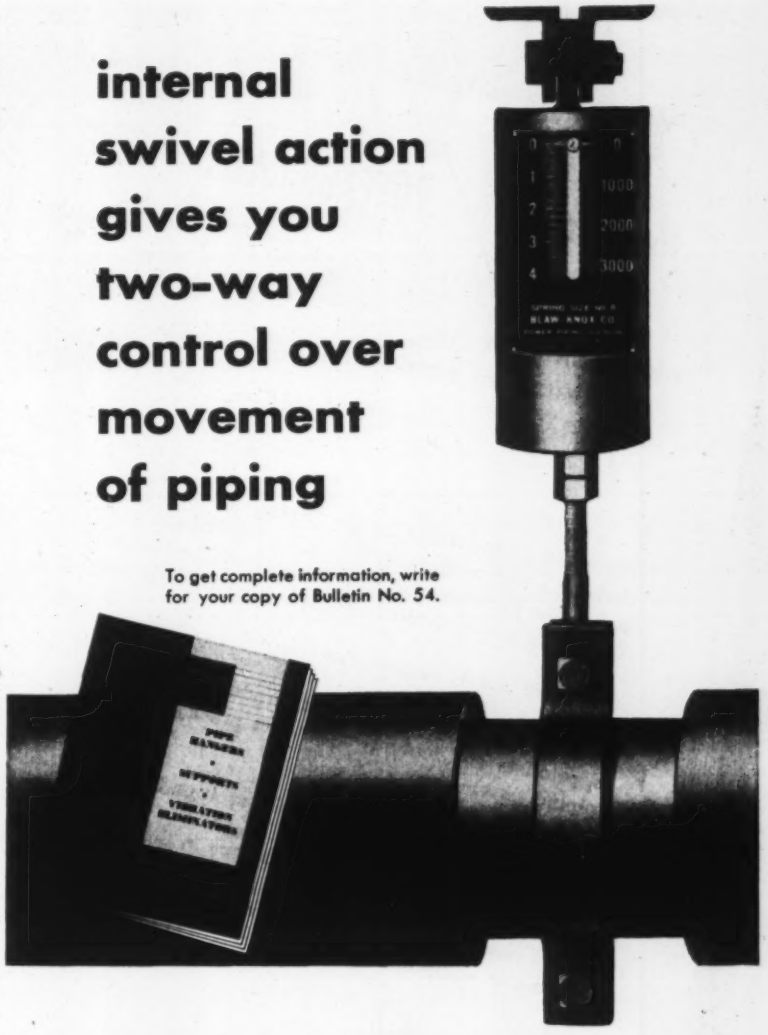
The Permutit Co., 330 West 42nd St., New York, N. Y., makers of all types of industrial and commercial water conditioning equipment and ion exchange resins, is building a modern metal-working plant at Lancaster, Pa. to expand and increase manufacturing facilities and to increase the sales potential of their varied products.

It is scheduled for completion by the spring of 1954. The new manufacturing plant will cost about $750,000 and will occupy 2 acres on a site of approximately 30 acres.

The plant will be of modern design, with all facilities on one floor. It should give better service and closer attention to the needs of customers and will provide a more suitable working space that can be expanded when required. The consolidation at Lancaster of two similar activities in plants at Brooklyn, N. Y. and Philadelphia, Pa., will effect substantial economies. It will be the finest operation of its type in the industry.

The Brooklyn, N. Y., plant will be vacated early in 1954 and transfer its equipment, augmented by new production apparatus to the new location as soon as possible. Later in the year, the manufacture of Simplex Valve & Meter Co. products, now produced in Philadelphia, Pa., will also be transferred to Lancaster. Neither the main executive and sales office at New York, nor the manufacturing plant at Birmingham, N. J. will be affected by this expansion move.

internal swivel action gives you two-way control over movement of piping



To get complete information, write for your copy of Bulletin No. 54.

You can readily control both the lateral and longitudinal swing movements of your piping up to 7° with our functional spring hanger.

For the hanger is designed with the Blaw-Knox patented *internal swivel action*, which permits movement while the hanger case itself remains vertical. Larger movements are readily accommodated by overhead roller assemblies. Each is a complete packaged unit ready to install.

In fact, our entire line of rigid hanger assemblies, overhead roller assemblies, vibration eliminators, as well as the functional hangers, are furnished as complete units . . . thereby saving you engineering time and eliminating expensive cutting, threading and assembling in the field.

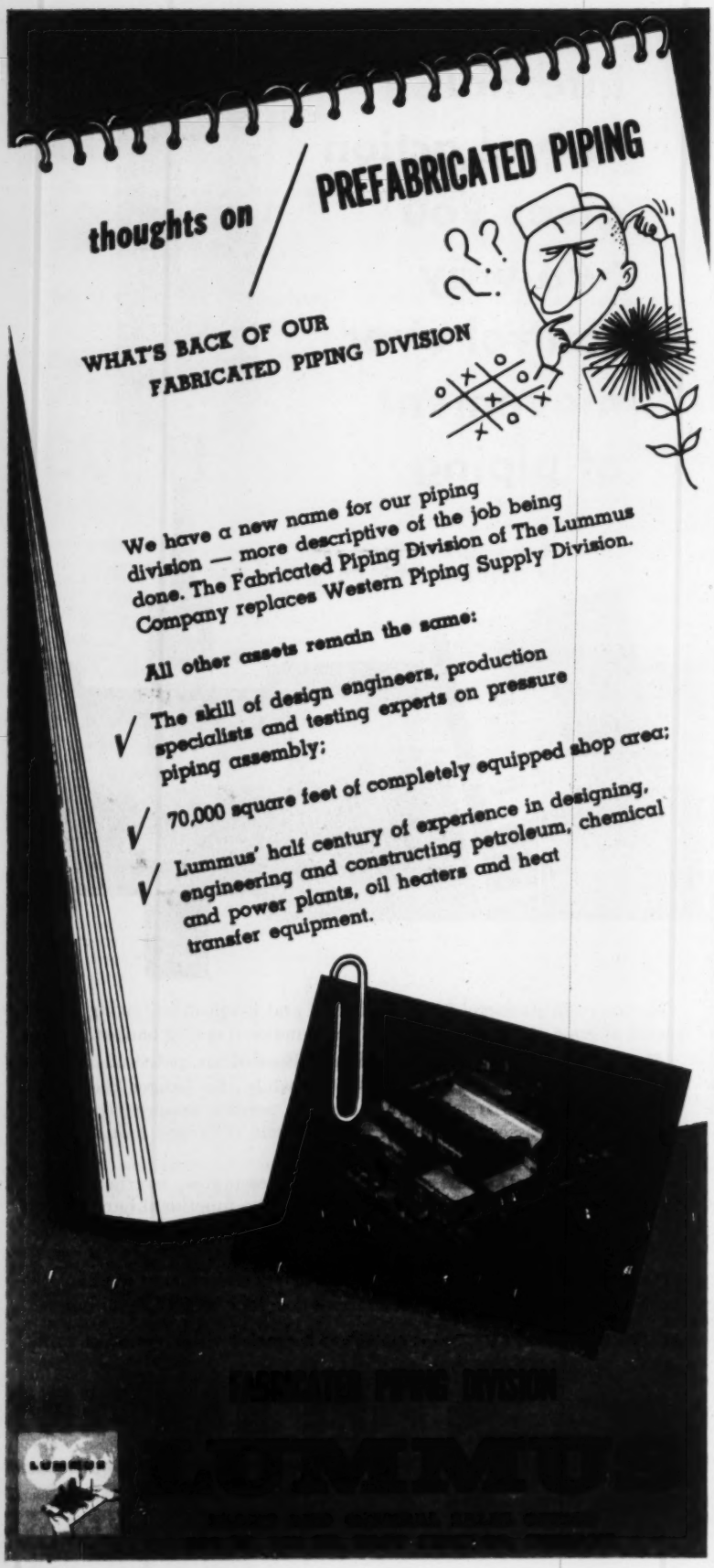
Our engineers, who have had years of experience, are available to both design and make recommendations for your hanger requirements.

BLAW-KNOX COMPANY, Power Piping and Sprinkler Division, Pittsburgh 33, Pa.

BLAW-KNOX

PIPE HANGERS

Complete line of functional spring hangers • rigid hanger assemblies • overhead roller assemblies • supports • vibration eliminators . . . plus complete prefabricated power piping systems for all pressures and temperatures.


thoughts on
PREFABRICATED PIPING
WHAT'S BACK OF OUR
FABRICATED PIPING DIVISION
We have a new name for our piping division — more descriptive of the job being done. The Fabricated Piping Division of The Lummus Company replaces Western Piping Supply Division.
All other assets remain the same:
The skill of design engineers, production specialists and testing experts on pressure piping assembly;
70,000 square feet of completely equipped shop area;
Lummus' half century of experience in designing, engineering and constructing petroleum, chemical and power plants, oil heaters and heat transfer equipment.

Tinius Olsen Appoints Ohio Representative

Appointment of the Research Instrument Co. as Ohio sales representative has been announced by the Tinius Olsen Testing Machine Co., Willow Grove, Pa. With offices located at 12410 Triskett Rd., Cleveland, the Research Instrument Co. will handle the entire line of Olsen physical testing equipment for the state of Ohio with the exception of several counties adjacent to the Pittsburgh area.

New Cone-Drive Representative

Appointment of Transmission Engineering Co., Inc., 244 N. 22nd St., Philadelphia 2, Pa., as sales engineers to original equipment manufacturers in Delaware, southeastern Pennsylvania, southern New Jersey and eastern Maryland is announced by F. E. Birtch, Manager, Cone-Drive Gears Div., Michigan Tool Co. of Detroit.

H. H. Fry is manager of the 20-year old Philadelphia firm which has been serving industry in this area since 1947 as a Cone-Drive jobber. Transmission will maintain its jobbers' outlets as well as take on the increased scope of sales engineers.

Sterling To Distribute Parker O-Ring Products

Sterling Packing & Gasket Co., Inc., of 1703 Nance St., Houston 1, Tex, has been signed as a distributor of Parker O-Rings according to an announcement from the Parker Appliance Co. of Cleveland, Ohio.

C. L. Fenity, Jr., vice president and general manager of Sterling indicated his firm will stock standard service O-rings in a wide range of sizes.

This distributor will have available the assistance of M. L. Sheehan, Parker representative in the Texas and Southwest district. Parker is a major national producer of hydraulic and fluid system components for industrial machines and processes.

Opens New Michigan Sales Office

Titeflex, Inc. of Newark, New Jersey, announces that it has opened a new sales office for the state of Michigan at room 641, Book Building, 1249 Washington Blvd., Detroit 26, Mich. In charge of the office will be Titeflex sales representative Edward Frank.

Titeflex engineers and manufactures Titeflex metal hose, Uniflex seamless metal hose, precision metal bellows, Titeflex electrical connectors, electrical fuses, rigid and flexible wave guides, and ignition harnesses and shielding systems. The new sales office will facilitate the company's service to a concentrated group of its customers located in the Michigan area. Gordon J. Wygant is sales manager.

Continued on Page 67

Remember — the trade marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS, INC.

Engineered FOR ENDURANCE

THIS TUBE-TURN WELDING TEE is drawn from seamless tubing to a barrel shape—the form every tee wants to assume under pressure. This design, plus the generous crotch radius and thickness, assure exceptional strength and endurance. In tests of representative fittings, bursting pressures have averaged over 25% higher than required by applicable standards.

This extra quality at no extra cost is typical of all TUBE-TURN Welding Fittings and Flanges. For satisfying service, and to fill all your requirements from one reliable source, get in touch with your nearby TUBE TURNS' Distributor. You'll find one in every principal city.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS, INC. LOUISVILLE 1, KENTUCKY

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Chicago • Denver • Los Angeles • San Francisco Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

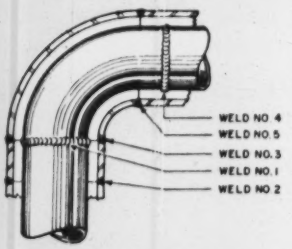
Subsidiaries: TUBE TURNS OF CANADA LIMITED, CHATHAM, ONTARIO • PENNSYLVANIA FORGE CORPORATION, PHILADELPHIA, PA.

TUBE TURNS' ENGINEERING SERVICE

develops new method of fabricating jacketed fittings

FABRICATION TIME AND COST can be reduced with this method of using welding fittings for directional changes in jacketed piping systems. The jacketed fitting combination consists of long and short radius TUBE-TURN Welding Elbows, with center-line radii closely matching. A tangent on one end of the inside elbow (see cut) extends beyond the corresponding end of the outside elbow. On the other end a short length of pipe is attached to simplify installation.

The method eliminates the need for steam and coolant jumpers, and also eliminates flanged joints, except where disassembly must be provided for. Insulation can be readily applied. Maintenance costs are sharply reduced, as all joints are permanently leakproof. The assembly provides optimum flow conditions, and minimized thermal problems.



Welding sequence for elbow of jacketed system.

This improved technique is another contribution to piping technology by TUBE TURNS' Engineering Service Division—always ready to help you with special piping problems.

TUBE TURNS, INC., Dept. F-2
224 East Broadway, Louisville 1, Kentucky

Please send me free copy of Pipe and Fitting Materials.

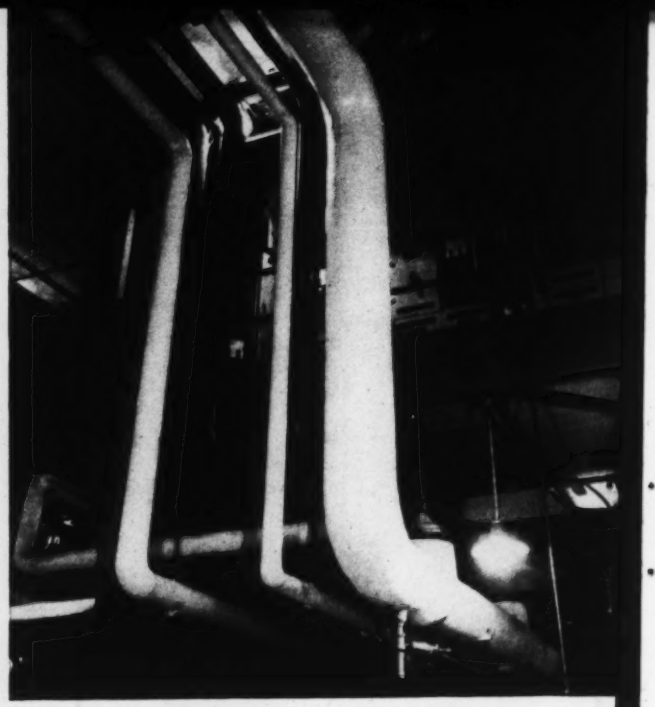
Company Name _____

Company Address _____

City _____ *Zone* _____ *State* _____

Your Name _____

Position _____



These water, steam, and air lines, using TUBE-TURN Welding Fittings to make directional changes, provide permanently leakproof service. Note compactness of layout, and how neatly insulation is applied.

SERVICE is the middle name of your nearby TUBE TURNS' Distributor. He can help you fill all your requirements from one reliable source. TUBE TURNS, INC. offers the world's broadest line of welding fittings and flanges, in a wide range of types, sizes, and more than 40 different alloys.

DISTRICT OFFICES

New York	Midland
Philadelphia	Tulsa
Pittsburgh	San Francisco
Cleveland	Los Angeles
Chicago	Seattle
Houston	Atlanta
Dallas	Denver

"TUBE-TURN" Reg. U. S. Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

KEEP INFORMED

NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Changes Cleveland Office Address

Dravo Corp., Machinery Div., Pittsburgh, Pa., announces that effective December 21st its Cleveland office will be located at 4207 Chester Ave., Cleveland 3, Ohio.

The Cleveland office, under Walter R. Hoffman, district manager, handles the sale of Dravo's Counterflo, Paraflo and Unit Heaters; Crane Cab Cooling and Pulpit Air Conditioning equipment; fabricated piping and construction services.

The office also serves as manufacturers' representative for De Laval Steam Turbine Co.; Cochrane Corp.; C. H. Wheeler Mfg. Co.; Walker Process Equipment, Inc.; Fuller Co.; Cleaver-Brooks Co. and Oxy-Catalyst, Inc.

LATEST CATALOGS

Weld-Lok Tube Fittings

The Parker Appliance Co., 17325 Euclid Ave., Cleveland 12, Ohio, announces publication of Catalog No. 4370 which presents a new line of socket type Weld-lok tube fittings for permanently welded joints.

The new line of Weld-lok tube fittings are available in steel or stainless steel for all commonly needed body shapes. Sizes range from 1/4-in. through 2 in. outside diameter. The line includes unions, adapters, connectors, tees, crosses, gage connectors and elbows.

Parker, a major national producer of hydraulic and fluid system components, added the new line for applications involving extreme temperature conditions or wherever permanently welded tubing circuit joints are required.

The new catalog is available on request.

Pressure Switches and Valves

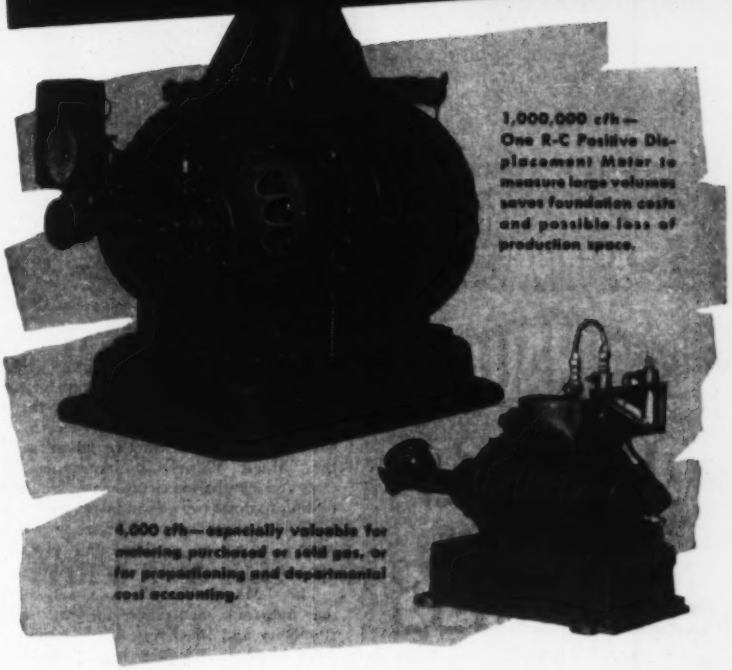
Pressure switches and valves are covered in the new 20-page Barksdale Catalog 3G. "Shear-Seal" valves for manual control of vacuum or pressures up to 6000 psi are illustrated and explained in detail. Included are four-way, dual pressure selector, and shut-off models for pipe sizes up to 1 1/2 in. The second section contains complete data on solenoid controlled "Shear-Seal" valves, selector and shut-off, for service up to 3000 psi.

A chapter on 150 psi solenoid air valves has a convenient air discharge table to help in determining valve size.

The most useful ranges of diaphragm, bourdon tube, and piston actuated pressure switches have been tabulated to round off this hydraulic control manual.

The catalog may be obtained by writing Barksdale Valves, 5125 Alcoa Ave., Los Angeles 58, Cal.

CALL ON THE "Specialists" FOR ACCURATE METERING


1,000,000 cfh—One R-C Positive Displacement Meter to measure large volumes saves foundation costs and possible loss of production space.
4,000 cfh—especially valuable for metering purchased or sold gas, or for proportioning and departmental cost accounting.

The successful performance of Roots-Connersville Positive Displacement Meters has long been proved by large and small industrial plants and public utilities. These users rate them high in such basic essentials as:

Accuracy—not affected by pressure, wide ranges in loads or other variables. Absence of valves, vanes and other small parts insures "cash register" accuracy over years of use.

Capacity—from 4,000 cfh to 1,000,000 cfh in one unit, with ample ability to absorb overloads.

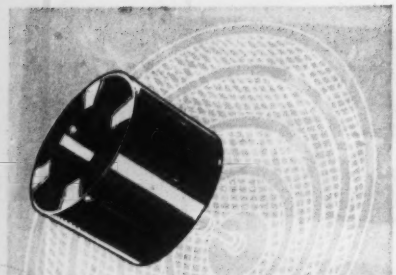
Compactness—smallest made for industrial use in foot-for-foot of capacity. Can be located in otherwise unusable space, thus saving production areas.

Almost a century of experience in handling gas and air, exclusively, goes into the design and construction of R-C Meters. They're part of the comprehensive line of blowers, exhausters, gas and vacuum pumps and related equipment, which are the products of R-C Specialists, and which are in widest use in industry.

ROOTS-CONNERSVILLE
Exclusive Specialists in Handling Gas and Air

A new bulletin, M-152, gives complete data on R-C Meters, including a handy selection table which simplifies your choice of the right meter to suit your specific application. Your copy will be sent on request.

ROOTS-CONNERSVILLE BLOWER
A DIVISION OF DRESSER INDUSTRIES, INC.
535 Michigan Ave. • Connersville, Indiana



ARE YOU SEARCHING FOR
HIGH PERFORMANCE
BEARINGS?

GRAPHALLOY

OIL-FREE
SELF-LUBRICATING
BUSHINGS

Work Where Others Won't!

EXCELLENT DURABILITY • CONSTANT COEFFICIENT OF FRICTION • APPLICABLE OVER A WIDE TEMPERATURE RANGE — EVEN WHERE OIL SOLIDIFIES OR CARBONIZES **• OPERATE DRY, OR AT HIGH SPEEDS SUBMERGED IN WATER, GASOLINE OR OTHER LIQUIDS • EXCELLENT FOR CURRENT-CARRYING BEARINGS**

GRAPHALLOY materials are also in wide use for oil-free, self-lubricating piston rings, seal rings, thrust washers, friction discs, pump vanes, etc.

Other Graphalloy Products

For applications requiring low electrical noise, low and constant drop, high current density and minimum wear. Used for SELSYNS, DYNAMOTORS, SYNCHROS, ROTATING STRAIN GAGE pick-ups and many other applications. Brush Holders and Coin Silver Slip Rings also available.

BRUSHES
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☐ Send data on BRUSHES and CONTACTS.

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Cathode-Ray Oscillograph

A descriptive bulletin on the Du Mont Type 301-A, a miniaturized wide-band, quantitative cathode-ray oscillograph, is available from Technical Sales Dept., Allen B. Du Mont Laboratories, Inc., 760 Bloomfield Ave., Clifton, N. J. Front cover of bulletin is an illustration of the front panel of instrument, while fold-outs of the bulletin illustrate depth of instrument, providing a full-size, three-dimensional mock-up of the Type 301-A. Electrical and mechanical specifications are included.

Electrostatic Neutralizer Bar

The Herman H. Sticht Co., Inc., 27 Park Pl., New York, N. Y. has just issued Technical Bulletin No. 125 which describes with illustrations the principles of operation and the characteristic properties of typical electrostatic neutralizers, and particularly the patented new "Magic Wand" electrostatic neutralizer. The distinctive advantages of the "Magic Wand" in improving processes and eliminating electrostatic fire and explosion hazards provide industry with a new tool for increasing production, preventing waste, improving quality, and protecting personnel from injuries and fatalities.

The "Magic Wand" is a self-energizing induction neutralizer of the utmost simplicity and effectiveness. It requires no external source of power thereby eliminating high voltage transformers, high tension cables and fittings.

Industrial Electric Heating

Principal industrial electric heating applications and methods are described in a new 32-page booklet, "101 Ways to Apply Electric Heat," by Edwin L. Wiegand Co., Pittsburgh, Pa., manufacturers of Chromalox electric heating units.

Illustrated case histories show experience-tested ways to apply metal-sheathed electric heating units in many industrial jobs. Physical aspects of installation are shown along with a description of the problem, solution and advantages obtained.

To illustrate liquid heating, for example, diagrams, photographs and captions show why contact-type strip, ring or tubular elements are chosen—while immersion or circulation heaters are more desirable in other cases.

Similar treatment is given to problems of heating air and gases; melting soft metals and viscous materials, and heating machinery and equipment parts, such as dies, platens, molds and moving parts. Other types of heating jobs are covered by industry, and include applications in metal finishing, plastics, chemicals, foundries and electroplating. A section is devoted to far-infrared heating, showing 28 typical uses for this new method.

For a free copy of the new Chromalox Booklet, write to Edwin L. Wiegand Co., 7646 Thomas Blvd., Pittsburgh 8, Pa.

Hydraulic Pumps and Motors

A new four-page bulletin has just been published by Hydreco Div. of The New York Air Brake Co., 1100 East 222 St. Cleveland 17, Ohio. Bulletin No. 139 points out features and gives selection data for the complete line of Hydreco oil hydraulic pumps and motors.

The outstanding features are labeled on a large cutaway that shows the inside of the pump/motor. And technical drawings are used to show the advantages of the Hydreco four-bolt design and the principle of pressure-compensated wear plates.

Other material in Bulletin No. 139 includes application photos and sketches that help the user select the design features needed for his particular application.

Hydreco manufactures oil hydraulic pumps and motors from sizes 3 to 130 gpm and for operating pressures up to 1500 psi.

Gas Unit Heater

A twelve-page technical bulletin, describing the complete line of Series 23A gas-fired unit heaters, has been issued by the United States Air Conditioning Corp. of Minneapolis.

The line includes propeller fan and blower type heaters, each produced in fourteen models, ranging in capacity from 55,000 to 500,000 Btu per hr. and burning all types of gas at the rated capacities.

Booklet, designated No. 23-3, includes capacity tables and roughing-in dimensions, as well as structural and operational descriptions of the entire line.

All Usairco gas-fired unit heaters feature specially designed heat exchangers, on which both hot spots and cold spots have been eliminated. The resultant even temperature removes the hazard of burn outs and rust outs due to overheating and underheating.

The literature can be obtained from the United States Air Conditioning Corp., 33rd and Como Ave., S. E., Minneapolis 14, Minn.

Give Gladly

THE UNITED WAY

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NEW EQUIPMENT
BUSINESS NOTES
LATEST CATALOGS

Water-Tube Package Boilers

A four-page folder published by The Bigelow Co., New Haven, Conn., gives details on the company's new line of shop-assembled, water-tube boilers.

The bulletin includes a description of the Type H boiler, along with illustrations of the unit in process of shop assembly and finally completed. Advantages are listed. Also shown are dimension drawings and a table of capacities, dimensions, and weights for ten standard sizes ranging from 8000 to 30,000 lb steam per hr.

Free copies of this new bulletin are available, on request, from the company's main office.

Granite Surface Plates

The Taft-Peirce Mfg. Co., Woonsocket, R. I. have issued Catalog No. 510 describing granite surface plates for precision measurements that require the ultimate in smooth flat surfaces.

Plates are precision ground and lapped to produce the most accurate surface available today. Surface accuracy is not affected by ordinary temperature changes. This dense granite has no internal stresses, and its unusual rigidity prevents distortion. Working surface is extremely smooth, yet the natural pores of the granite assure free movement of tools. This release in the air seal also eliminates the danger of erroneous measurements due to an "air cushion" under instruments. Surface is nonabrasive and easily cleaned with ordinary solvents. These surface plates are an important addition to a line of layout and inspection equipment.

Sizes range from 9 × 12 in. to 48 × 96 in., thickness from 4 in. to 14 in.

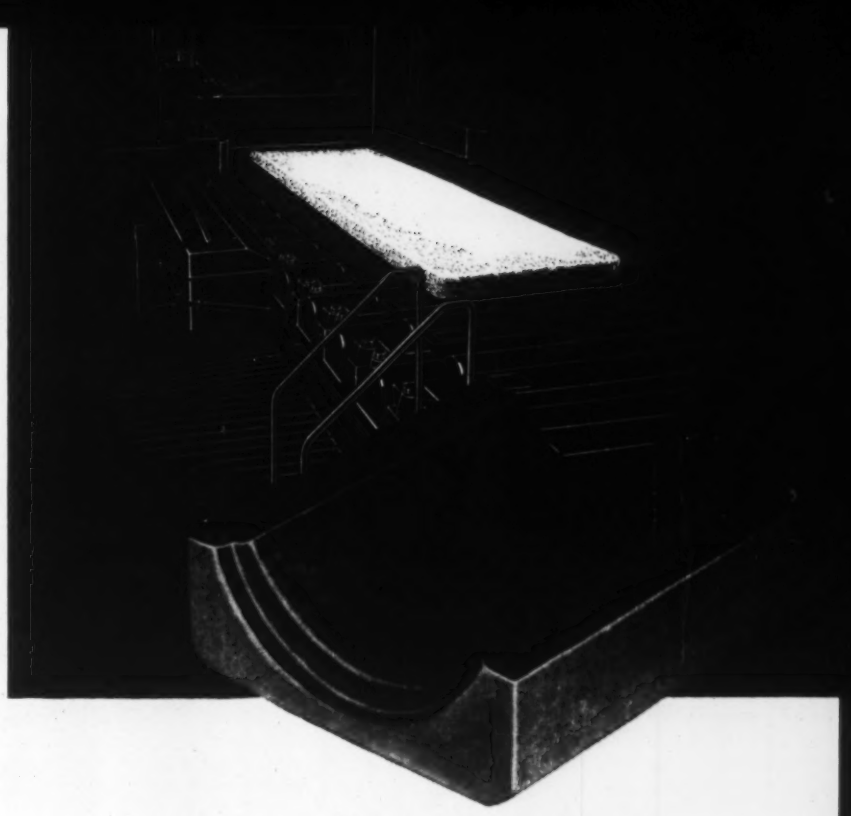
Automatic Controls on Variable Speed Drives

Reeves Pulley Co., Columbus, Ind., announces the availability of the new "Reeves Automatic Production Control Booklet," Bulletin G-537, which covers the complete line of Automatic Controls available on Reeves Variable Speed Drives.

This 24-page booklet describes not only the controls available but the means of solving problems involving the control of tension, the control of acceleration and deceleration, velocity and peripheral speed, synchronization of one or more machines, and the maintaining of uniform temperature, pressure, liquid level, flow, etc.

Included in the booklet is a complete description of all types of controls available, together with many schematic engineering tracings showing how these controls can best be utilized to increase production.

This new bulletin is the most complete control booklet available today and it is offered absolutely free. Write Reeves Pulley Co., Columbus, Ind., and request Bulletin G-537.



Here's what micarta® LAMINATED PLASTICS is doing for steel production!

A leading steel producer wanted a roll-neck bearing material that could cut power costs, increase tonnage and hold more accurate gauge. Now, thousands of MICARTA roll-neck bearings are performing efficiently in steel mills throughout the country.

What can Micarta do for you?

Your problem may be as simple as noise control or electrical insulation. Perhaps you need a material that resists moisture, that is lubricated with water, that is both light and strong, that wears smoothly, slowly. Whatever your problem, your industry, or your application investigate the qualities of versatile MICARTA. For prompt and complete information about MICARTA fill out the coupon below.

YOU CAN BE SURE...IF IT'S Westinghouse

micarta® is basic!

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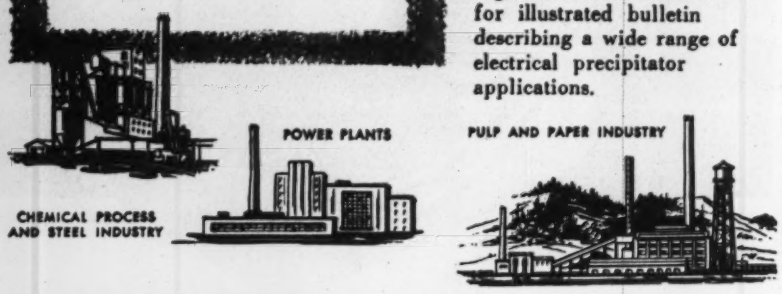
MICARTA Division, Trafford, Pa.
Attention: L. A. Pedley
Sir: (Please check one)
☐ Please have your representative call
☐ Please send me the complete facts on MICARTA
Name Company
Address
City Zone State
J-06512

Industry looks to
RESEARCH CORPORATION
for high dust collection efficiencies

To maintain visually clean stacks at all times, industry is turning to the long experience of Research Corporation in the design and manufacture of highly efficient Cottrell Electrical Precipitators. We've spent 40 years in solving such problems as nuisance abatement, cleaning gas for subsequent use and recovering materials of value. Write for illustrated bulletin describing a wide range of electrical precipitator applications.



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We Build Only PUMPS — The Finest of their Kind

APCO TURBINE-TYPE PUMPS

For the answer to any pumping problem — large or small—lasting dependability and consistent economy — may we suggest that you get acquainted with PUMPS by Aurora. They have pleased thousands. You, too, will like them.

AURORA CENTRIFUGAL PUMPS

AURORA Always PUMPS
AURORA PUMP COMPANY
DIVISION OF THE NEW YORK AIR BRAKE COMPANY
96 LOUCKS STREET, AURORA, ILLINOIS

New Fan Engineering Data Book

Valuable ventilation engineering information is included in Bulletin A-108, "Fan Engineering Data," newly issued by the Hartzell Propeller Fan Co., manufacturers of industrial air-moving equipment.

Among the material selected by Hartzell engineers for inclusion in this 16-page brochure are fans laws and formulas, terms and definitions, recommended velocities for exhaust hoods, an air pressure conversion table, and charts covering duct resistance, entrance losses and rectangular equivalents of round ducts.

Other sections discuss fan installation, maintenance and lubrication, explain noise problems, and show the characteristics of various propeller and wheel designs.

Copies of the new bulletin may be secured by writing to the Hartzell Propeller Fan Co., Piqua, Ohio.

Furnace Burners and Mixing Equipment

The American Gas Furnace Co., Elizabeth, N. J., has just issued Bulletin 630 on their line of furnace burners, mixing equipment, burner tunnels, zero governors, Venturi mixers, burner and single valve ratio set selection and installation and single valve ratio sets.

The bulletin is replete with illustrated and tabular information on the various types of burners, made of heat-resisting alloys for long life and freedom from repairs. The mixing units, namely single valve ratio sets give one valve regulation with a turndown ratio of 6 to 1 without appreciable change in the ratio of gas to air, this being an unusually wide operating range. Full installation and selection data are included in the bulletin as well as full data on single valve ratio sets.

Further information may be obtained by writing to the Company.

Valve-Mounted Flow Control

Bulletin 470, "Dynamic Flow Control," has been issued by The Foxboro Co., Foxboro, Mass., to introduce the Model 59 Valve-Mounted Controller for high-speed flow-control applications. The bulletin covers a typical flow control system, dividing it into its four components: the M/59 Controller; the set point transmitter (M/53 Recorder); the measurement transmitter (Foxboro d/p Cell); and the Foxboro Stabilflo Control Valve.

A two-page explanation of the M/59 Controller mechanism centers on the special provisions for proportional, derivative, and reset control actions. Four bellows operate within a sealed case to position a balance-beam and apply corrective output pressure to the control valve in response to a process upset or control point change. Complete controller specifications and diagrams are included in the bulletin, copies of which will be sent on request.

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Silicone Adhesive

The properties of silicone adhesives called XC-269 and XC-271 by Dow Corning Corp. are discussed in Silicone Notes No. 4-602, published by Dow Corning. Description, applying and curing, limitations, and typical properties are contained in the publication.

The silicone adhesives are said to give excellent adhesion to metals, glass, paper, fabrics, plastics, including polyethylene or polyester films, silicone rubber, silicone-treated paper, Teflon, and silicone-glass laminates or cloth.

Silicone Notes No. 4-602 is available from Dow Corning Corp., Midland, Mich.

Deaerating Heater

Cochrane Publication No. 4643 describes Cochrane's new "Uni-Pac" Deaerating Heater designed specially for small and medium size power plants. The deaerator is completely self-contained, and factory assembled for easy field installation on a variety of storage tank sizes by purchaser's personnel. The "Uni-Pac" delivers guaranteed zero oxygen boiler feedwater at low capital outlay.

Operation, design, capacities and detailed advantages are fully described. Address Cochrane Corp., 3142 N. 17th St., Philadelphia, 32, Pa.

Railroad and Industrial Springs

A 36-page catalog on industrial and railroad springs is available from Henry Miller Spring & Mfg. Co., Pittsburgh 15, Pa. Featuring a photographic presentation of each of the steps in spring manufacture, the catalog includes product pictures of springs for railroads, coke ovens, mine cars, tractors, presses, shears and other industrial applications.

The catalog illustrates the manufacturer's straight-line production layout, including such steps as shearing, tapering, quenching, heat-treating, painting, grinding and testing. Also shown are certain machining operations on dies and mandrels.

This catalog also includes specifications on springs for various sizes of freight cars and technical data from Specification M-114-48 of the Association of American Railroads. For a free copy write to Henry Miller Spring & Mfg. Co., 142 Davidson St., Sharpsburg, Pittsburgh 15, Pa.

Authoritative, idea-filled bulletin tells you all about metal bellows and bellows assemblies

Ideal for Design Engineers!

CONTAINS: Bellows construction data . . . Illustrations . . . Diagrams . . . Applications . . . Temperature conversion table . . . Altitude-pressure-temperature table

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Shop Stools and Chairs

A 12-page bulletin on Hallowell shop stools and chairs has been prepared by Standard Pressed Steel Co., Jenkintown, Pa.

The bulletin (No. 704-4) pictures and describes 14 steel stool models, including knock-down, adjustable, filing and revolving-seat stools, and three chair models.

Almost any desired height can be furnished. Seats are of steel, Presdwood-covered steel, round wood and shaped plywood. Hinge-type and clamp-type back rests are available in steel and plywood.

Address requests for bulletin to Standard Pressed Steel Co., Box 806, Jenkintown, Pa.

Differential Pressure Transmitter

The Swartwout Co., manufacturer of process control, power plant, and industrial ventilating equipment, announces a new bulletin on the Autronic Differential Pressure Transmitter.

The four-page bulletin describes the Type D2T transmitter in detail and gives data on principles of operation. It is illustrated with hook-up and schematic diagrams, phantom-cutaway views, dimensional diagrams, etc.

Copies of Bulletin A-707-A are available on request to The Swartwout Co., 18511 Euclid Ave., Cleveland 12, Ohio.

Aluminum Industrial Roofing and Siding

Corrugated aluminum roofing and siding, which is finding a rapidly increasing market as a building material for industrial shops and buildings, is described in a new booklet published by Aluminum Company of America.

An outstanding feature of the booklet is the story it tells about the maintenance-free characteristics of aluminum as a building material. Installations of corrugated aluminum roofing in excellent condition after over 20 years service in industrial areas are outlined to the reader.

The 16-page booklet describes in detail, with comprehensive drawings, the easy and efficient methods of applying Alcoa corrugated Industrial Roofing and Siding. Application methods outlined include fasteners such as self-tapping screws, Nelson Rivweld studs and Widman fasteners. Accessories for application of Alcoa roofing and siding such as flashing, ridge roll and closure strip are detailed, as are loading tables and weight and coverage tables. Drawings present roofing and siding details on basic types of industrial structures.

The booklet also shows details on the construction of an insulated industrial wall. This wall is made from a sandwich of two layers of corrugated aluminum with a center of insulating material.

The booklet, "Alcoa Aluminum Corrugated Industrial Roofing and Siding," can be obtained by writing to Aluminum Co. of America, 804 Alcoa Bldg., Pittsburgh 19, Pa.

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General-Purpose Oscillograph

A new publication, GEC-449B, on the general-purpose oscillograph, has been announced as available from the General Electric Co., Schenectady 5, N. Y.

For use in investigation, design, and testing, the GE Type PM-10 oscillograph permits simultaneous records to be made of voltage, current, time, speed, pressure, strain, and sound. Features and operation of the equipment are explained in the 12-page bulletin, which also contains descriptive information, pricing data, and information on accessory equipment.

Other G-E electric instruments for industrial and central station use are listed.

Slow-Speed Power Drives

Sterling Electric Motors, New York 51, N. Y. has issued bulletin covering their slow-speed electric power drives in a wide range of horsepowers and types with balanced engineering from power intake to drive shaft. Various types are shown in illustrations showing unit, gearing, mounting and shaft.

Another bulletin describes their variable speed electric power drives for controlled operation. Shown for remote and automatic speed control, mechanical and electrical with or without speed indicators.

Distribution Regulators

Introduction of distribution regulators has brought about many changes in system economics. Application of these smaller, lower cost units provides increased revenue, greater flexibility and improved customer relations on existing systems.

A new 12-page bulletin describing the external and internal features of Allis-Chalmers distribution regulators (Type JFR) has been released by the company.

The design and construction details of the latest "Quick-Break" tap-changing mechanism, improved "Feather-Touch" control and unit construction are pictorially displayed and discussed. Examples of how easily the regulators can be installed—at a substation, on a pole or platform near the load—are also given.

Listed in the bulletin are the standard accessories and specifications for the Type JFR distribution regulator which is now available in ratings of 2,500 volts, 100 and 200 amperes; 5,000 volts, 50 and 100 amperes; 7,620 volts, 15, 50 and 100 amperes, and 14,400 volts, 50 and 100 amperes.

Copies of the bulletin, "Allis-Chalmers Distribution Regulators," 21B7977, are available on request from Allis-Chalmers Mfg. Co., 949 S. 70th St., Milwaukee, Wis.

Imported Pumps and Valves

Neumann & Welchman, 37 Wall St., New York 5, N. Y. have issued a composite folder bulletin covering the centrifugal pumps, valves and fittings manufactured by Rheinhuette, Wiesbaden-Biebrich, Germany. The above are sole sales representatives in U.S.A.

Illustrated tabular and specification data are included on their line of acid and corrosion resistant centrifugal pumps. Types described are acid pumps, self-priming acid pumps, screw impeller acid pumps, full-way tubular impeller pumps, acid and sewage sump pumps, cement slurry pumps, all-purpose pumps.

Valves described include globe, angle, gate, check, non-return, swing, safety, flush bottom tank, ammonia and for pneumatic, hydraulic or motor operation. Valves for corrosives, acids, alkalis, chemical pulps and liquids. Line also includes liquid level gages, pipes, standard valves for water and gas.

Pumps and valves are available in the following alloys: special grey cast-iron RH 94, 15-16 per cent silicon-iron, chromium cast, stainless chrome-nickel steel, hard lead, special gun metal, silumin, cast-iron hard rubber, or neoprene lined. For further information write to above importers.

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Mark collets, tubing and other round parts or products of various diameters, economically with this machine. Part is placed on mandrel and a quick turn of the lever rolls marking into metal neatly and legibly. Investigate today!

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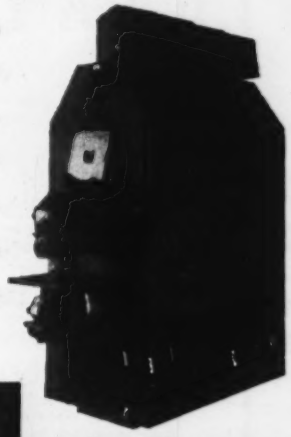

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ARTHUR A. OLSON & COMPANY
BROAD STREET, CANFIELD, OHIO

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Diaphragm Motor Valves

Twelve-page Bulletin 362 describes the high quality, low cost Series 362 line of diaphragm motor valves for on-off or narrow band proportional control. Complete specifications are given for both type 26 single seated and type 27 Bellows sealed valves. Write to Minneapolis-Honeywell Regulator Co., Wayne and Windrim Aves., Philadelphia 44, Pa.

New Multi-Point Recorder-Controller

An informative four-page technical data bulletin covering Multi-Point Circular Chart Recorders has been prepared by Fielden Instrument Div., Robertshaw-Fulton Controls Co. Bulletin describes and illustrates the many new design features which make this unit unique in the field of circular chart recorders. Fielden's exclusive "Turret" pen assembly makes possible six individual records on a single circular chart. Through a "Segmental" chart drive unit, the new Fielden instrument becomes either a 24, 48, or 96 point Multi-Record system. Construction features and specifications are also included. Free copies available from Fielden Instrument Div. at 2920 N. Fourth St., Philadelphia 33, Pa.

Lock Nuts

A 12-page catalog showing the various types of Palnut Lock Nuts, including details of design and locking principle, assembly advantages, typical applications, methods of assembly and other engineering information on dimensions, screw tension pounds, materials and finishes. For a copy of Catalog No. 573-A, write The Palnut Co., 113 Cordier St., Irvington 11, N. J.

Wavometer

Micrometrical Mfg. Co., 345 S. Main St., Ann Arbor, Mich., announces an 8-page illustrated bulletin on the Wavometer, a shop instrument for measuring the average microinch height of waviness irregularities around symmetrical surfaces of rotation such as bearing races.

The bulletin explains why practically all machined and finished surfaces are wavy; describes the characteristics of waviness on surfaces of rotation; discusses the advantages gained through measurement and control of waviness; and describes the operation of the Wavometer and the information revealed by the instrument's two microinch meters, oscilloscope, and loudspeaker. It also tells how to specify Wavometer readings on drawings and shop prints.

Lift Truck

Now available is a new eight-page illustrated catalog on the Hyster YT-40 Lift Truck. The YT-40 is a 4000-pound capacity model featuring trunnion-mounted steering and pneumatic tires. It is an all-purpose, inside-outside truck. Complete description, specifications and actual on-the-job photos are included in the catalog. Copies may be had free from any Hyster dealer, or by writing Hyster Co., 2902 N. E. Clackamas St., Portland 8, Ore. for Form 1284.

Dust Collection

The general problem of dust collection in the food and processing industries and Aerodyne Dust Collectors are discussed in a new Bulletin No. 171 recently published by The Green Fuel Economizer Co., Inc., 926 Main St., Beacon, N. Y.

Titled "Industrial Dust Collection," the bulletin is designed to help engineers evaluate the desirability of installing Aerodyne dust collectors by telling of the advantages gained in installing an Aerodyne. Included are a full explanation of the theory and design of the Aerodyne and drawings of the various types of Aerodyne Collector Systems; also photographs and listings of some recent Aerodyne installations.

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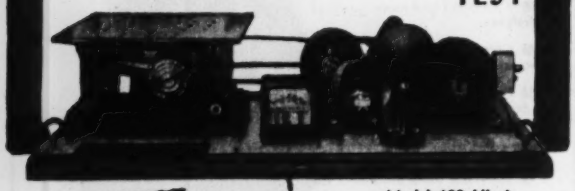

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Model 100 HL-A
Capacity 100 lbs. Produces vibrations horizontally. New 4-point linkage arm table support.

NATIONAL Bureau of Standards uses four, Mass. Inst. of Technology two, Western Electric 13, Westinghouse and G. E. 12 each. Basic equipment for YOUR testing laboratory or inspection department. In many plants a laboratory in itself. Detect excess weight—find structural weak spots.
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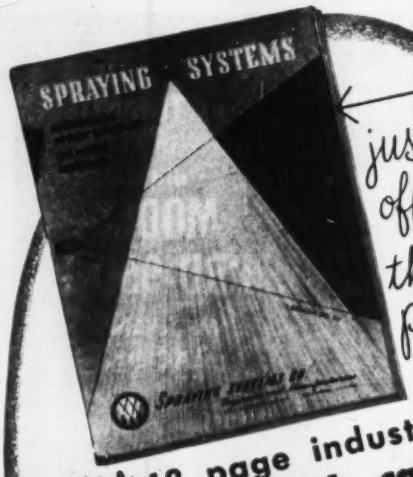

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Here's the most comprehensive industrial spray nozzle catalog ever printed. Complete data on thousands of standard and special nozzles for every type of spraying.

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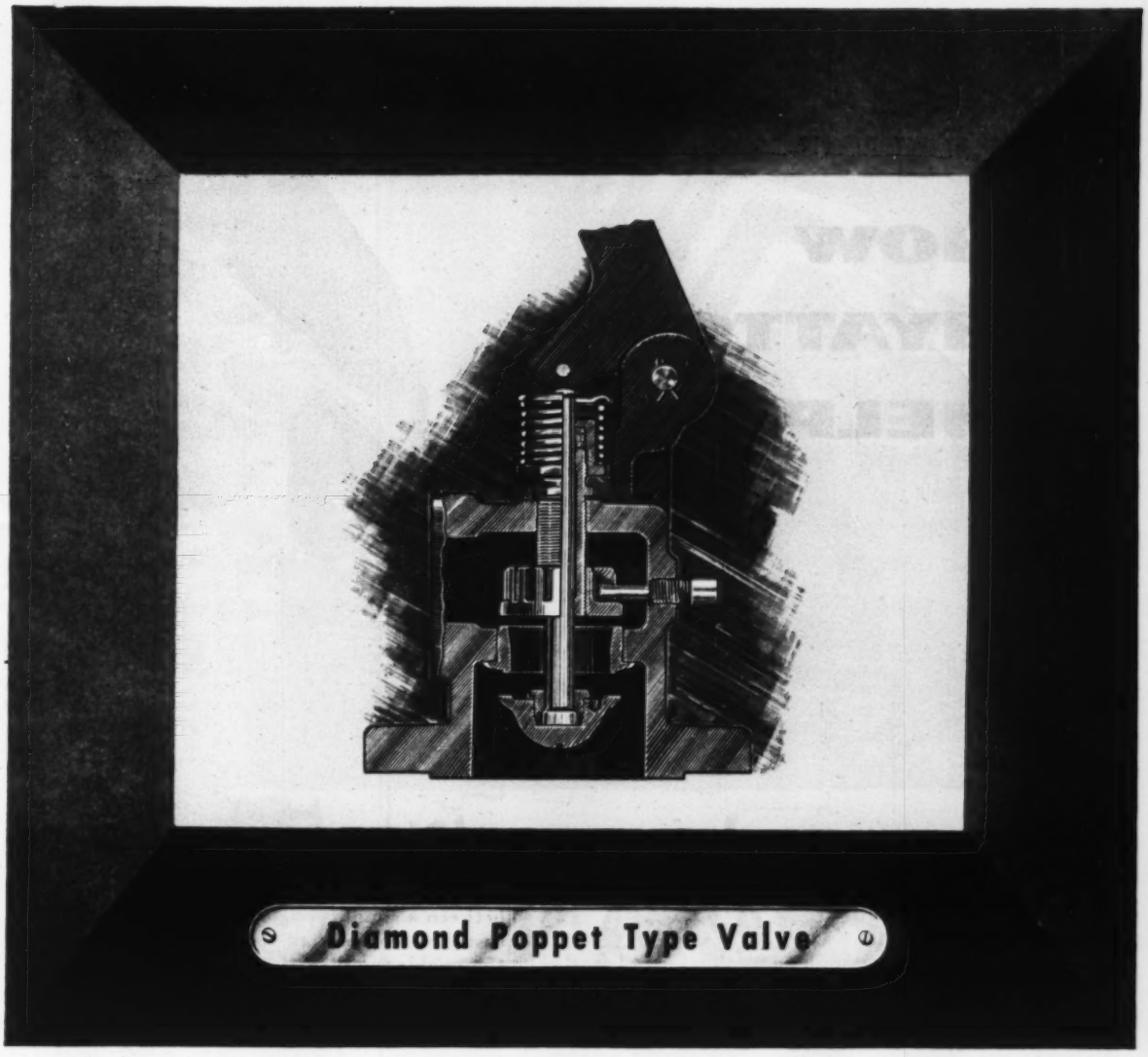

An Engineering Masterpiece

More than 300,000 Diamond Poppet Type Valves control the flow to Diamond Models G9B, IR and IK Blowers. Long experience has proved this design most satisfactory for such severe service. Diamond construction assures tight seating every time without close adjustments. Valve seat is welded in for high pressures, and Stellited seating surfaces are available. Integral adjustable pressure control (located outside the path of valve travel) does not interfere with full and immediate opening of the valve, thus avoiding wire drawing. Micrometer-like adjustment permits very close regulation at low flow rates. Throttling at the back seat eliminates this damaging action on the main seat. No line orifice is required. Mechanical action is direct without pilot or diaphragm actuation. Rugged stem, proper guiding and small packing surface result in minimum maintenance.

This engineering masterpiece is one of the important reasons for the superiority of Diamond Blowers.

6654

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Diamond Specialty Limited, Windsor, Ontario

when LIMITED SPACE is a design factor

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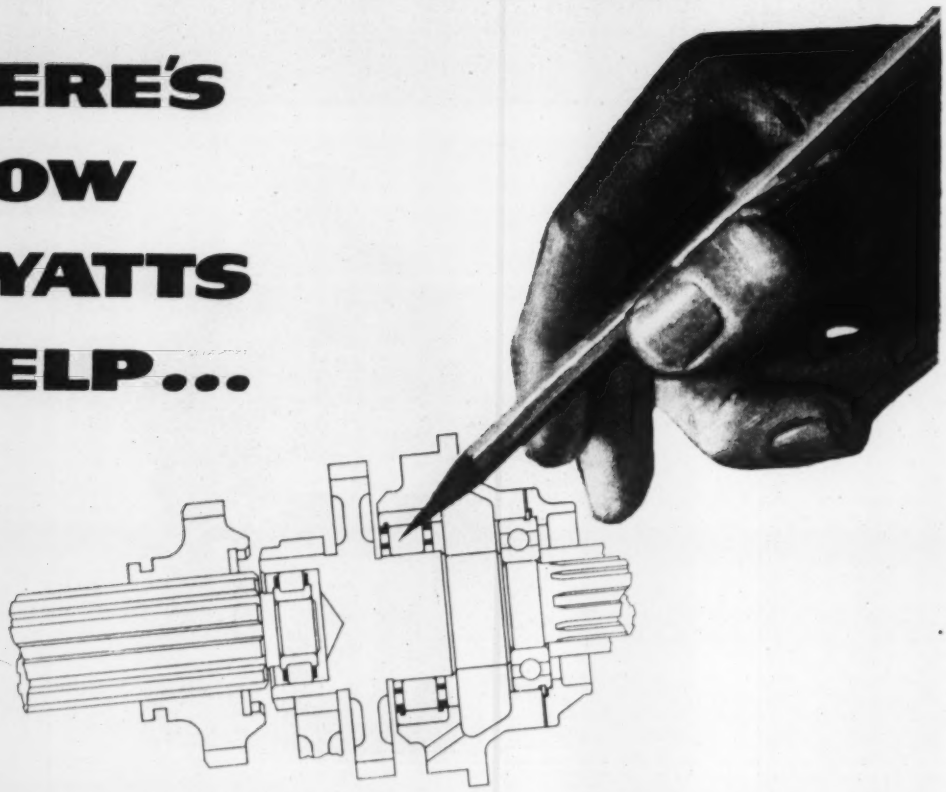
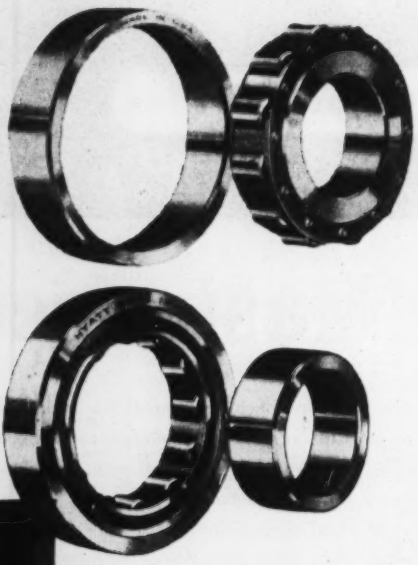
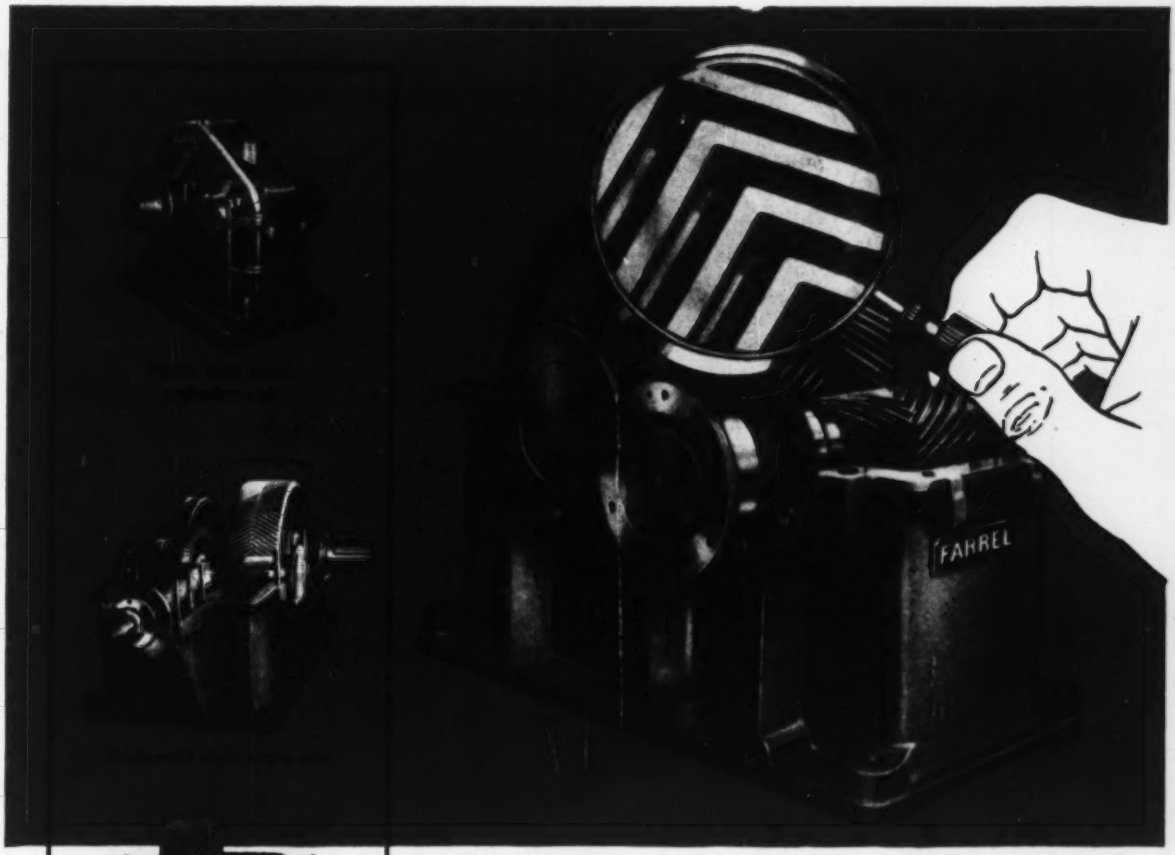


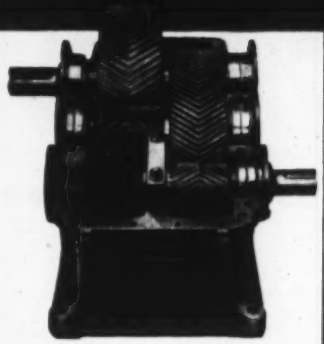


Sometimes a fraction of an inch is the difference between a simple design modification and costly re-tooling. And the engineer who is thoroughly familiar with Hyatt Roller Bearings will know a lot about how to save those fractions. He'll know, for example, that to gain greater shaft rigidity with the same size housing, he need only check his Hyatt catalog for a separable inner race type of bearing. This type—available in a wide range of sizes—may be applied with the rollers operating directly upon the surface of a suitably hardened and ground shaft. Thus, a larger-diameter shaft may be used without sacrificing bearing capacity, or a larger-size bearing may be used without changing the size of the shaft. For a copy of Hyatt's latest catalog, No. 150, write to Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

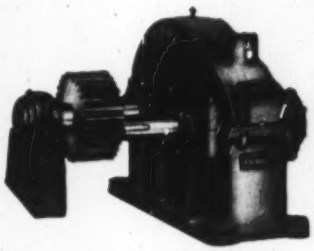
HYATT ROLLER BEARINGS

STRAIGHT | BARREL | TAPER





Standard double reduction unit



Unit with pinion on extended shaft supported by outboard bearing

Close-up of a way of life for Speed Reducers

Long, trouble-free speed reducer life is vitally dependent on precision generation of the gears.

The gears of Farrel® speed reducers are made by the famous Farrel-Sykes method — a process that assures accuracy of tooth spacing, profile and helix angle. The herringbone design provides evenly distributed pressure over each tooth, from tip to working depth line. This means that there is no tendency for the teeth to wear unevenly and thus shorten the life of the gears.

Shafts and bearings are factored to safeguard against interruption of vital processes. Gear cases are proportioned to withstand repeated heavy peak loads. Joints are sealed to prevent entrance of dirt.

Farrel speed reducers are made in a number of types, with a wide range of ratios and capacities. Designs include single, double and multiple reduction units, speed change units having two or more selective speeds, right angle drives, and drives to meet special requirements.

Wherever power transmission must be smooth, quiet, and vibrationless under all conditions of load and speed, *specify Farrel speed reducers.* For further details, send for a copy of bulletin 449.

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FB-840

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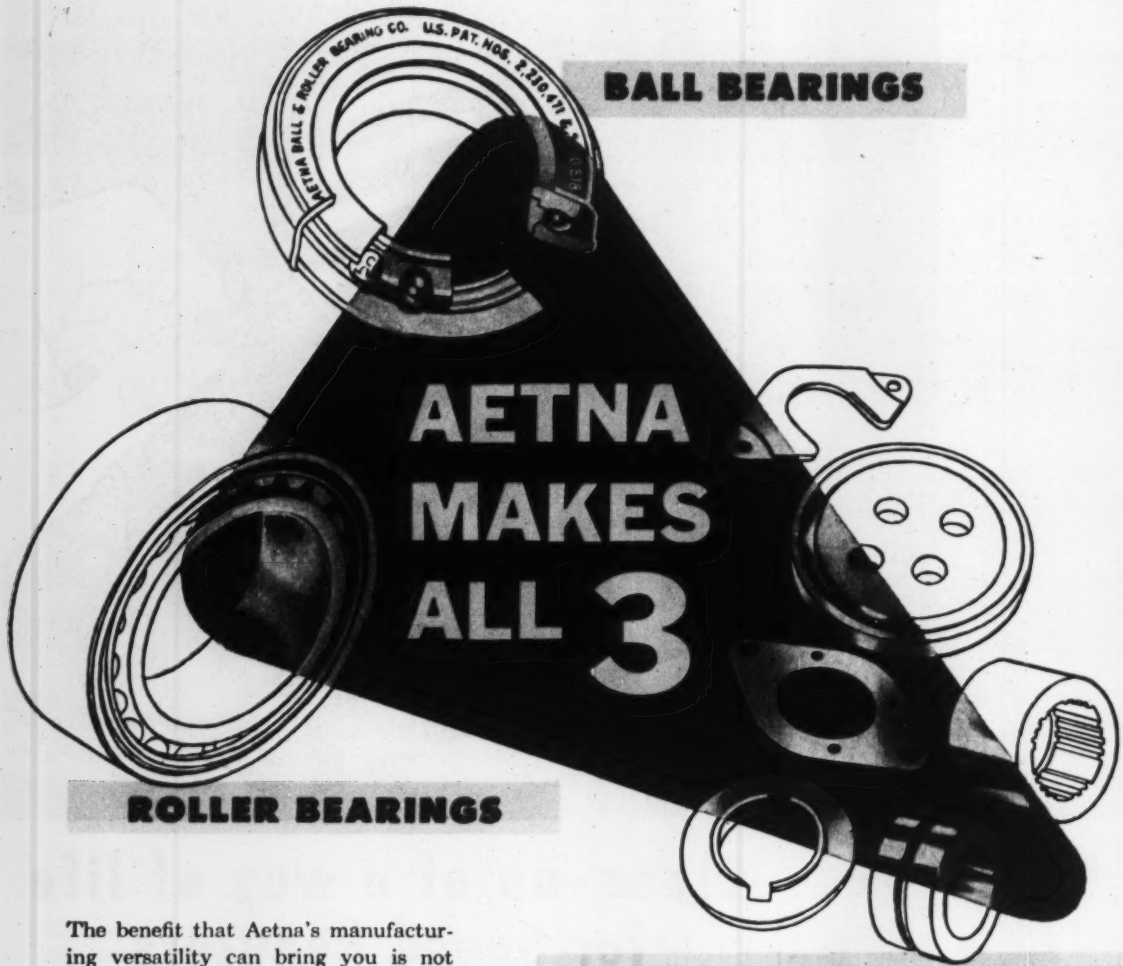

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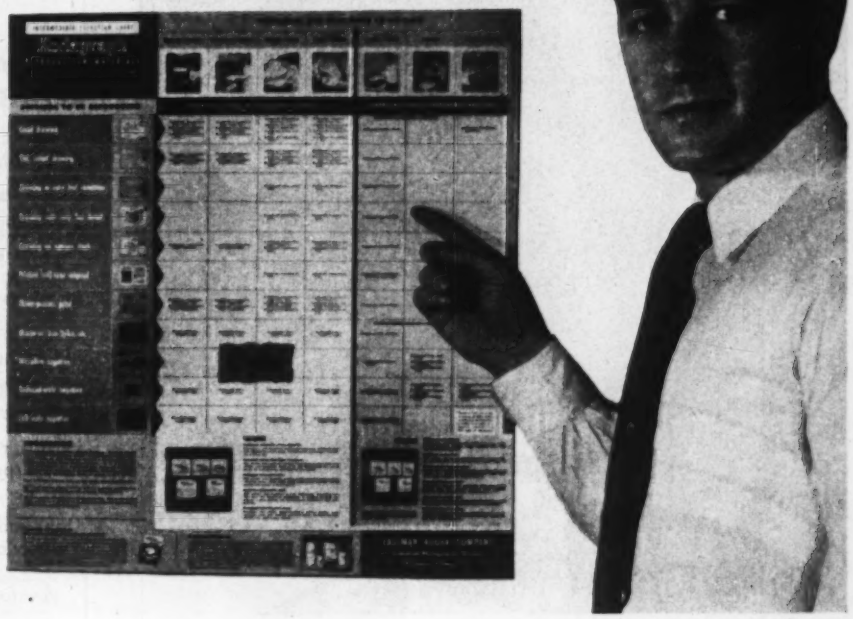

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this handy wall chart lets you select immediately the Kodagraph Reproduction Material which will give you best results in reproducing any type of drawing or other original in any type of print-making equipment.

Whether you do your own print-making or order from a local blueprinter, you will find this selection chart a helpful time-saver. And a money-saver, too, for these materials do not involve complicated techniques and are surprisingly low in cost.

The chart tells you, among other things, *which* Kodagraph Materials are specifically designed to give you sharp, clean intermediate prints of old, soiled drawings; which Kodagraph Materials are best for reproducing blueprints, microfilm negatives, drawings with extremely fine detail, printed halftone pages, etc.

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"THE BIG NEW PLUS" in engineering drawing reproduction

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THESE TWO EXAMPLES SHOW YOU

What Nordstrom Means by "Lubricaut

Nordstrom three-way Transflo valves on relief service at top of propylene tower separating propylene from propane.

TYPICAL NORDSTROM REFINERY APPLICATIONS

- Catalytic Polymerization
- Crude Topping and Vacuum Distillation
- Fluid Catalytic Cracking and Gas Recovery
- Distillate Recovery in Cycling Plants
- Duo-Sol Solvent Extraction
- Houdriflow Catalytic Cracking and Gas Recovery
- Light Ends Fractionating
- Thermal Cracking
- Phenol Extraction
- Propane Deasphalting
- Cycloversion
- Delayed Coking
- Girbotol Process
- Propane Dewaxing
- Hydroforming Process
- Naphtha Polyforming
- Solexol Process
- Solvent Dewaxing
- Thermal Reforming

Nordstrom has compiled a series of specification sheets for each of these processes, showing recommended materials, pressure classes, lubricants and valve figure numbers. Ask your Nordstrom sales engineer to review them with you.

TYPICAL NORDSTROM PROCESS INDUSTRY APPLICATIONS

- Beverage Plants
- Cement Plants
- Chemical Plants
- Explosives
- Food Plants
- Gas Plants
- Ice and Refrigeration
- Paint and Lacquer
- Paper and Pulp
- Pharmaceuticals
- Power and Steam Plants
- Rubber Plants
- Sewage Plants
- Smelters and Mines
- Soap Factories
- Steel Mills
- Sugar Refineries
- Synthetic Ammonia
- Synthetic Fibers
- Synthetic Plastics
- Synthetic Rubber
- Tanneries
- Textiles and Dyes
- Water Works

The new Nordstrom Corrosion-Resistant Valve Bulletin V-217 will make it easy for you to fit the right valve to each service. Write for a copy, Rockwell Manufacturing Company, Pittsburgh 8, Pa., or ask your Nordstrom sales engineer.

-Sealed for POSITIVE SHUT-OFF"

Here are two typical Nordstrom valve process applications—one is a propylene tower, the other a dry hydrogen line.

They illustrate an important point in specifying valves for process service . . . if really tight shut-off of hard-to-hold gases or fluids is important, no valve can do the job better than Nordstrom.

Why? Because Nordstrom is the original lubricated plug valve. Nordstrom is the valve with the extra seal of plastic lubricant around the valve ports to check seepage of even the lightest, most penetrating substances.

That, of course, means greater safety, and greater economy, too, because when leakage is prevented, valve life is far longer. And most important, it means uninterrupted operation of continuous process units—no down-time for avoidable valve repairs.

The same lubricant that seals, also keeps the valve ready to operate in an emergency.

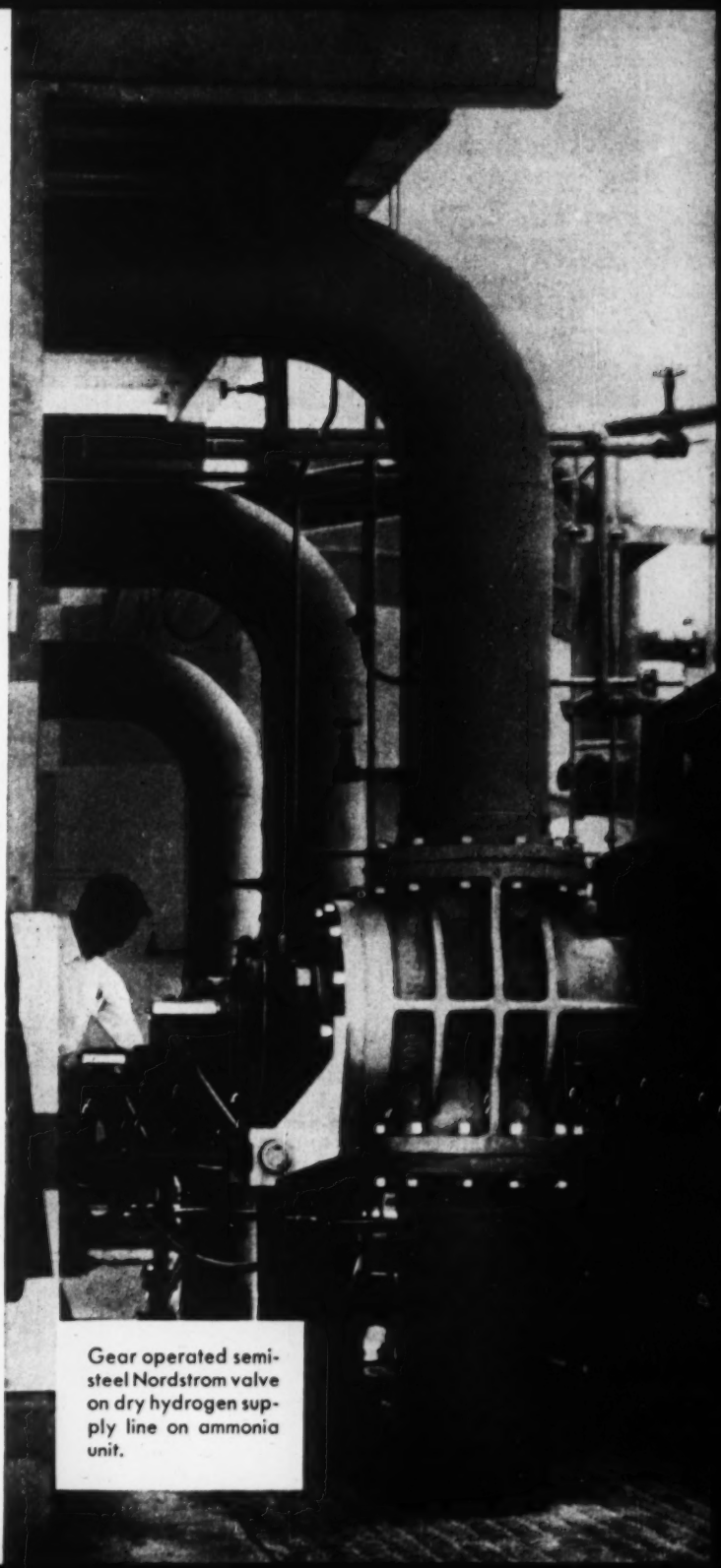
Nordstrom valves are built in a wide range of sizes, pressures, special metals and body designs for the process industries, including three- and four-way designs for batching, blending and switching. Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Canadian Licensee: Peacock Brothers, Limited

ROCKWELL Built Nordstrom Valves

Lubricant-Sealed for Positive Shut-Off

Another ROCKWELL Product



Gear operated semi-steel Nordstrom valve on dry hydrogen supply line on ammonia unit.

How would YOU solve these two problems?

1. HE LIKES LIFE SAVERS because they're good. Life Savers Corporation had the problem of *exactly* determining candy moisture content — required 1°F temperature control — found this *accuracy* in Fenwal All-Purpose THERMOSWITCH® unit. Cost of control was low — results excellent.

2. PARAFFIN BATHS are important physical therapy equipment. For safety, temperature must be held within close limits. Makers of Dickson Paraffin Baths selected Fenwal THERMOSWITCH devices as entirely dependable and accurate in controlling heating unit.

3. A FENWAL THERMOSWITCH CONTROL may solve your problems, too. Its external, single-metal shell expands or contracts *instantly* with temperature changes, making or breaking enclosed electrical contacts. Compact, highly resistant to shock and vibration, Fenwal THERMOSWITCH units have solved hundreds of otherwise costly problems.

4. SEND FOR THIS NEW CATALOG for complete explanation of the unique THERMOSWITCH unit. Also ask for more detailed, illustrated discussions of the problems above. Fenwal engineers will be glad to help you solve your temperature control problems involving heat, humidity, radiant heat, pressure and other variables. **Write Fenwal Incorporated, 52 Pleasant Street, Ashland, Massachusetts.**

Fenwal

THERMOSWITCH®

Electric Temperature Control and Detection Devices

SENSITIVE... *but only to heat*

1 Noble & Westbrook shell-marking machine with Bulletin 609 manual flush starter.

2 Leeds&Northrup Micromax Panel with Bulletin 609 manual flush-type starter.

3 Hamilton No. 1 gear hobber with Bulletin 709 flush starter in machine base or frame.

When you *design* a new machine

modernize its appearance with flush-type starters

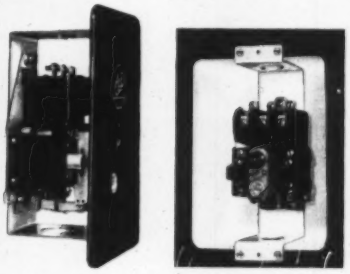
It is a sales asset to any device to have a trim, streamlined appearance . . . and it costs so little if you think of it while your product is still on the drawing board. A good place to start is to include convenient recesses or cavities in your machine frames or pedestals for flush-type Allen-Bradley motor controls.

Allen-Bradley manual and magnetic starters are available in snappy looking faceplates and skeleton mountings, ready to slip into your machine frames. See illustrations above.

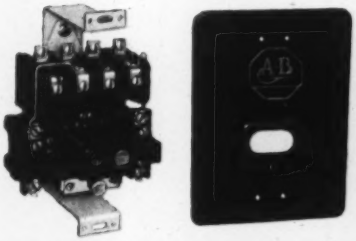
Your nearest Allen-Bradley control engineer will gladly call at your convenience and discuss the flush-type starters best suited to your need. (See illustrations at left.) Allen-Bradley controls are your assurance of trouble-free operation and long life.

Allen-Bradley Co., 1316 S. Second St., Milwaukee 4, Wis.

FLUSH-TYPE MOTOR STARTERS



Bulletin 609 Size 1 Manual Starters for flush cavity mountings



Bulletin 709 Size 1 Solenoid Starters for flush cavity mountings

1-54-R

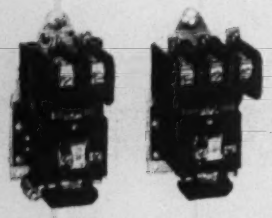
ALLEN-BRADLEY

MOTOR CONTROL

QUALITY

CONTACTORS

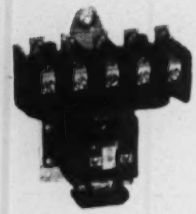
A-C & D-C • Sizes 00 to 7 • Ratings 10 to 900 Amperes



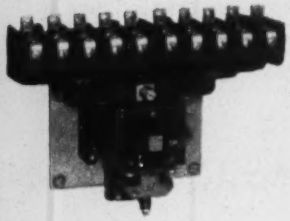
2 pole—Size 1
25 ampere

3 pole—Size 1
25 ampere

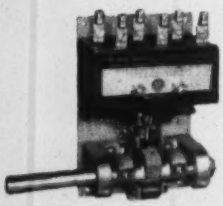
4 pole—Size 1
25 ampere



5 pole—Size 1
25 ampere

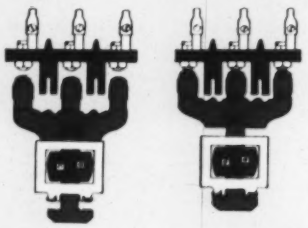


10 pole—Size 1
25 ampere



3 pole—Size 2
50 ampere
cam-operated
contactor

ALL SOLENOID OPERATED

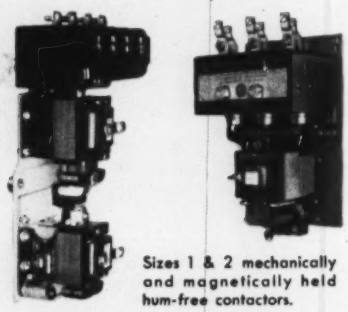


Contacts Open Contacts Closed

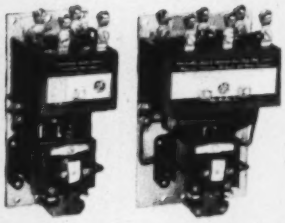
Here is the only complete line of solenoid contactors on the market . . . We have nine sizes from the little Size 00 (10 amperes) to the big Size 7 (900 amperes).

What does this mean to you? It means that all of your contactor requirements . . . from the smallest to the largest . . . can be met with Allen-Bradley trouble free solenoid controls. There is no contact maintenance . . . no pins, pivots, or bearings to stick and give trouble. Just one moving part—the simple solenoid plunger. Operating characteristics are consistent throughout all nine sizes.

Enclosures are available, too, for general purpose, watertight, dust-tight, and explosion-proof service. Allen-Bradley controls are a sales asset to any electrical device. May we send you our latest catalog?

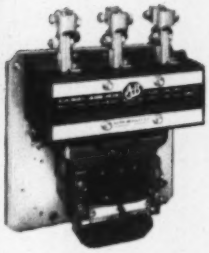


Sizes 1 & 2 mechanically and magnetically held hum-free contactors.

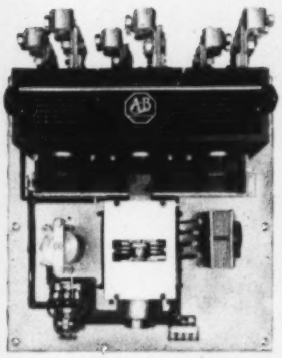


2 pole—Size 2
50 ampere

3 pole—Size 2
50 ampere



3 pole—Sizes 4 & 5
150 & 300 ampere
contactors



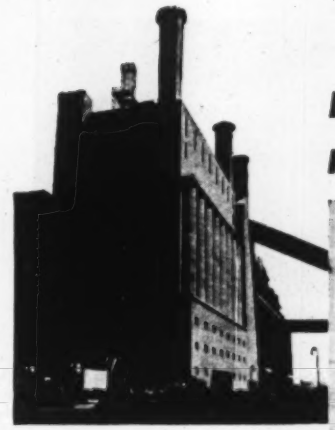
3 pole—Sizes 6 & 7
600 & 900 ampere contactors

Allen-Bradley Co.
1316 S. Second St.
Milwaukee 4, Wisconsin

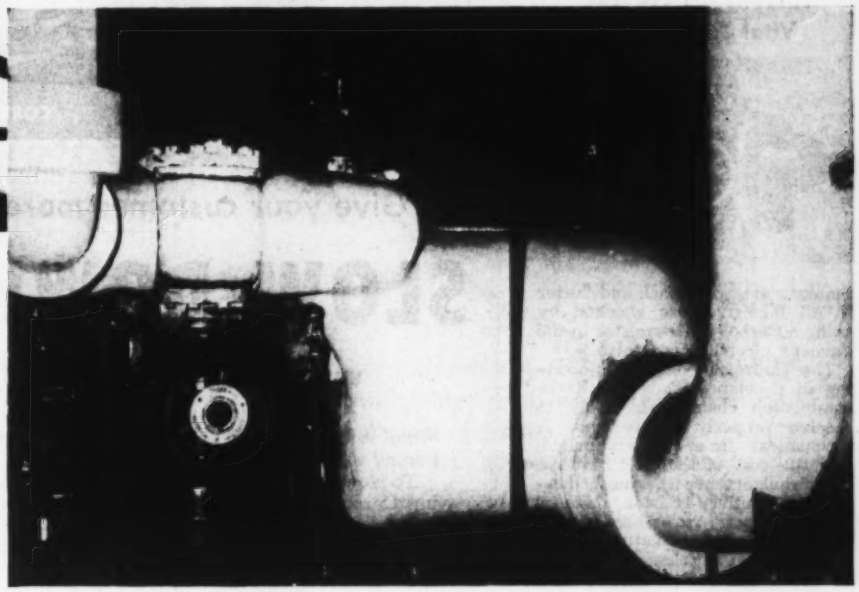
A-B Quality

ALLEN-BRADLEY
SOLENOID CONTACTORS
QUALITY

1-54-R



For this new addition to their New York City power plant at East River and 14th Street . . .



(Above) View of recently completed annex to Consolidated Edison's power plant . . . another link in their gigantic expansion program. **(Right)** Close-up of J-M 85% Magnesia Insulation on boiler feed lines. It was expertly installed by the Asbestos Construction Company, Inc., an outstanding J-M Insulation Contractor.

CON EDISON SPECIFIES J-M 85% MAGNESIA PIPE INSULATION FOR MAXIMUM FUEL SAVINGS

Like all materials that went into the new power plant addition of New York's leading gas and electric supplier . . . the pipe insulation had to be the *best*. That's why Consolidated Edison Co. specified J-M 85% Magnesia . . . industry's No. 1 insulation for many decades and *still* the leader in its class.

J-M 85% Magnesia is the leading insulation on the market for temperatures up to 600F. It is bonded with asbestos fibers. This rugged insulation will not distort regardless of the length of time it stays in service. J-M 85% Magnesia fits snug and stays put. Heat savings, therefore, remain constant for the life of the equipment on which this insulation is applied.

For temperatures over 600F, J-M 85% Magnesia is used in combination with Superex*, a J-M insulation for service to 1900F. This double-layer construction, known as Superex Combination, eliminates through joints and protects the jacket against scorching. It also utilizes the higher heat resistance of Superex next to the hot surface, and the greater insulating value of J-M 85% Magnesia for the outer layer.

*Reg. U.S. Pat. Off.

Experience has proved that all insulations must be properly installed to pay maximum dividends. That's why Johns-Manville offers industry the services of experienced insulation engineers and installation contractors who have made a career of solving complex insulation problems. From coast to coast, these engineers and the contractor's highly skilled mechanics stand ready to combine their talents and give you an insulation job that will more than pay off your initial investment with maximum fuel savings through the years.

When you face your next insulating problem . . . remember that Johns-Manville is "Insulation Headquarters." Consult your near-by J-M Insulation Contractor . . . or write direct to Johns-Manville, Box 60, New York 16, New York. In Canada, write 199 Bay Street, Toronto 1, Ontario.

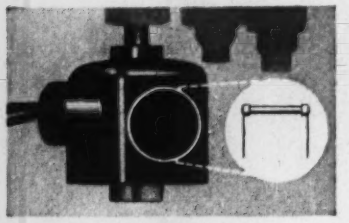
Skilled Applicators on the team of a J-M Insulation Contractor applying J-M 85% Magnesia to pipelines. Located throughout the nation, these contractors have had years of experience handling all types of installations. They know J-M 85% Magnesia and other J-M insulations as *quality* products, and take pride in applying them properly. Result: an insulation job that pays dividends through the years in maximum fuel savings.

Johns-Manville *FIRST IN* INSULATION

MATERIALS • ENGINEERING • APPLICATION

News About Created-Metals

Thermistors Provide Vital Time Delay

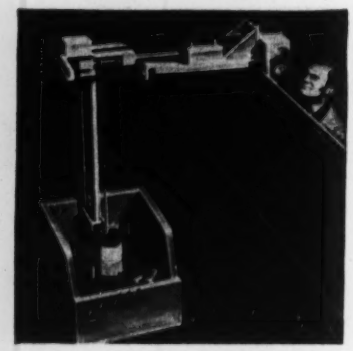


Smoky starts, puff-back and flutter in oil burners were checked by using a Carboloy Thermistor in the burner's electrical control.

The Thermistor delays the opening of a solenoid valve until the combustion chamber is ready to receive properly aerated oil. A mechanical timer is eliminated, and the cost of the unit reduced.

Thermistors are the most thermally sensitive resistor material known. Their resistance – unlike metals – changes negatively with temperature increases. They are ideal for temperature compensation, temperature detection, warning devices and controls. For more information, write: Carboloy Department of General Electric Company, 11133 E. 8 Mile Ave., Detroit 32, Michigan.

Hevimet Containers Stop "Hot Atoms"



Containers made of Carboloy Hevimet are making the job of handling and transporting radioactive materials easier and safer.

Because Hevimet is almost 50% heavier than lead, and provides 40% more gamma ray protection, these containers are smaller, less bulky . . . yet safer than lead.

Hevimet is an ideal material for all radioactive shielding. It is readily machinable, dimensionally stable and of high tensile strength. For more information, write: Carboloy Department of General Electric Company, 11133 E. 8 Mile Ave., Detroit 32, Michigan.

Give your customer more for his money

SLOW DOWN WEAR

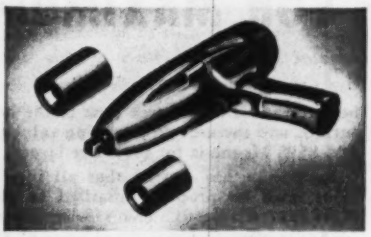
with Carboloy® cemented carbides

Wear is the common denominator of all equipment, reducing life, accuracy and greatly increasing costs.

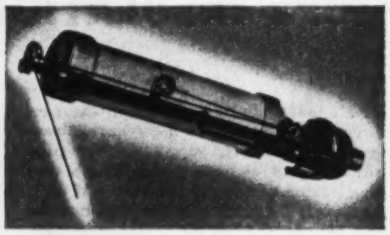
To slow down wear, many product and machine designers are applying Carboloy cemented carbides. In most instances, wherever friction, corrosion, erosion or abrasion are met, Carboloy cemented carbides can increase durability *many times over.*

These three case histories are typical of many more which may suggest important wearproofing possibilities for your own machines and products.

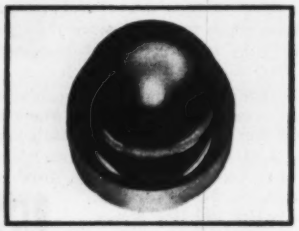
Look over *your* products and call upon the Carboloy Engineering Appraisal Service for expert assistance. We will work with you in selecting and applying the cemented carbide that will best solve *your* wear problem. This service is free. Please write.



Power socket wrenches, equipped with carbide inserts, outlasted ordinary wrenches a minimum of 15 to 20 times; eliminated screw, product damage caused by wrench slippage; sharply cut socket replacement costs and production line downtime.



In textile mills, threads traveling at high speeds quickly cut through steel or porcelain guides. Carbide guide ring inserts, used to resist such wear, lasted 50 to 100 times longer. They also greatly reduced thread snagging and snapping, spoilage and downtime.



Subsurface pumps in oil wells use balls and seats of Carboloy cemented carbide to resist acids and abrasive sands found in crude oil. Carboloy balls and seats outlast steel 20 times; maintain sphericity under severest conditions of impact and pressures.

Put These Outstanding Characteristics To Work In *Your* Plant:

- High abrasion resistance
- High corrosion resistance
- High erosion resistance
- High heat resistance
- High impact strength
- Non-magnetic
- Light weight (where desired)

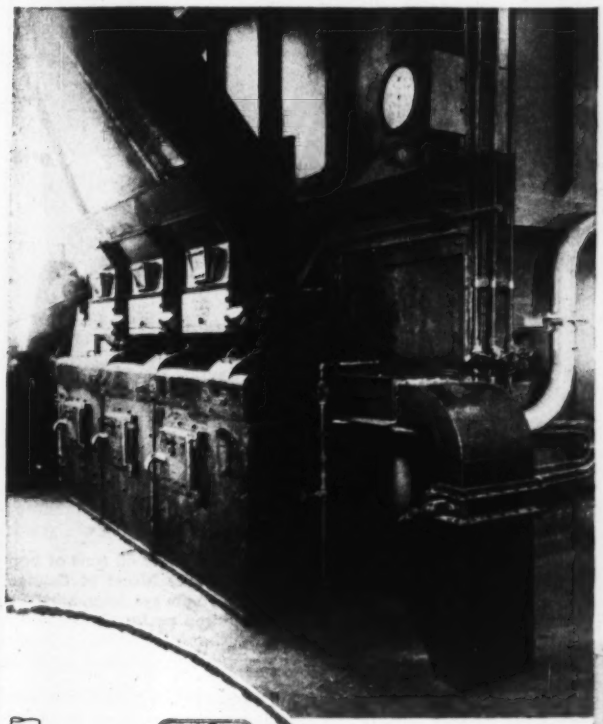
CARBOLOY

DEPARTMENT OF GENERAL ELECTRIC COMPANY
11133 E. 8 Mile Ave., Detroit 32, Michigan

"Carboloy" is the trademark for products of the Carboloy Department of General Electric Company

24 hours a day 7 days a week

Detroit RotoGrate Stoker in Ladish Malting Co.



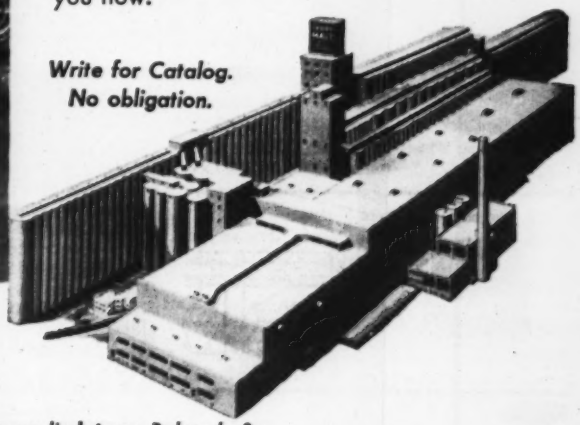
Exceptional reliability and very high availability are an utmost necessity in malting plant operation.

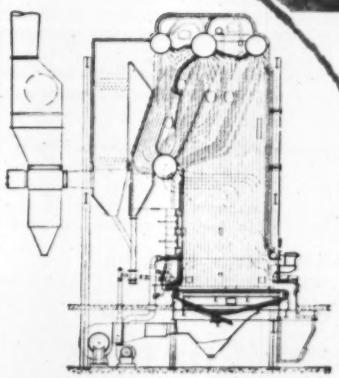
Enormous quantities of steam are needed in the Jefferson Junction, Wisconsin, plant of the Ladish Malting Co. for power and process. Ten million bushels of malt are manufactured annually. Steam generating equipment operates 24 hours a day and 7 days a week.

Difficult firing problems are always best solved by the use of Detroit RotoGrate Stokers.

Why not let them start saving money for you now.

Write for Catalog. No obligation.





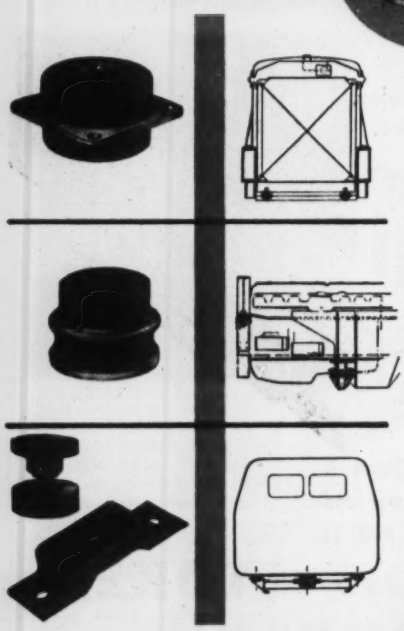
Detroit RotoGrate Stoker applied to a Babcock & Wilcox—4 drum Stirling Boiler with Superheater and Economizer Capacity 75,000 pounds. 410 psi 600° F.

DETROIT STOKER COMPANY

GENERAL MOTORS BLDG., DETROIT 2, MICH.

WORKS IN MONROE, MICH.

LORD Bonded-Rubber Mountings... As RUGGED AS THIS



The world's largest "off-the-road" truck, Model 60 Dart, hauls 60 tons of copper ore from the huge shovels in the pits of The Bagdad Copper Mines of Bagdad, Arizona to the mine rim over tortuous, twisting, climbing roadways impossible for any other means of transportation. Contributing to the desired performance of this mammoth vehicle, Lord Bonded-Rubber Mountings cushion the twin radiators against vibration and shock, thus protecting the vital cooling system and reducing maintenance costs.

The two 350 hp. diesel engines and transmission assemblies are protected from the shocks of rough going by Lord Mountings . . . these same mountings provide a barrier between damaging engine vibration and the truck itself. To complete the job Lord Mountings protect the cab.

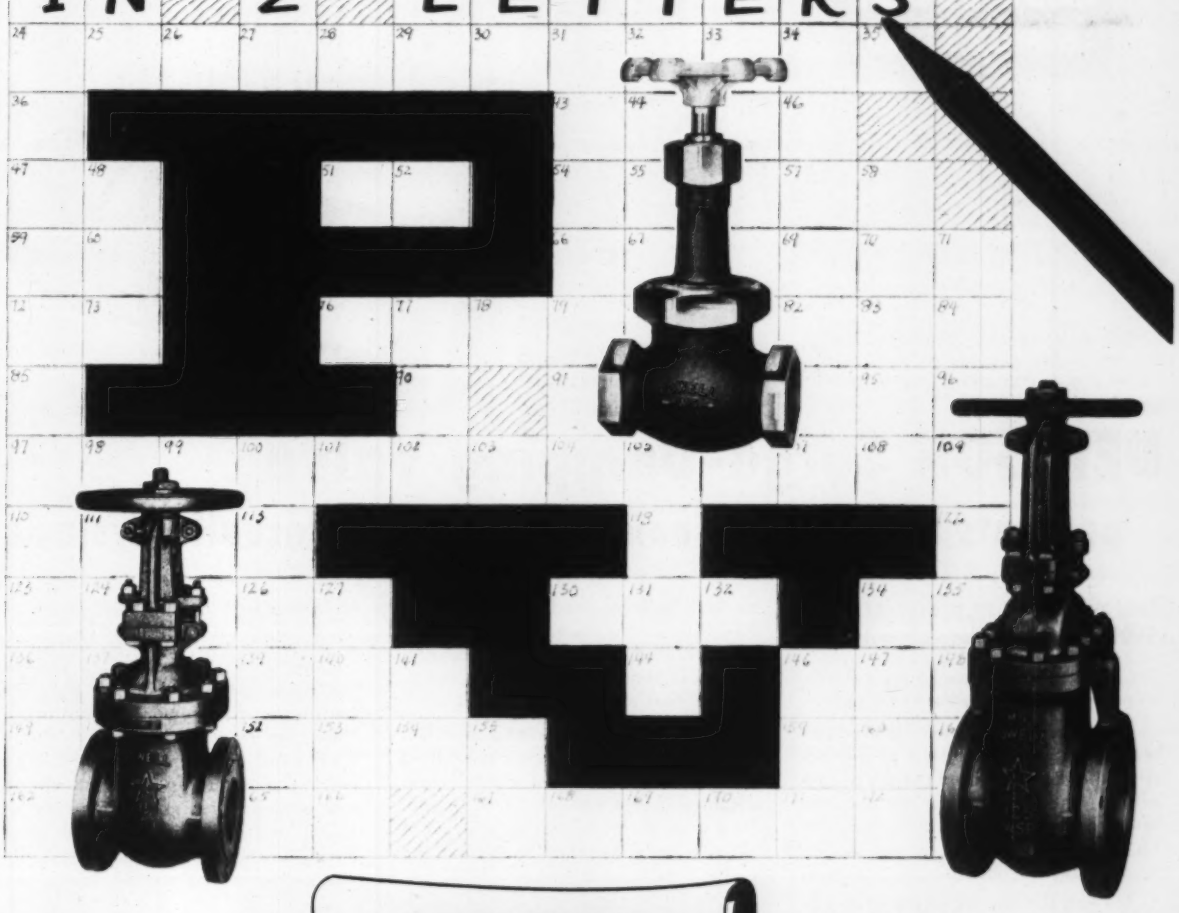
As rugged as the products they protect, Lord Bonded-Rubber Parts are used every day to improve the performance of industrial products large and small . . . Let us work with you.

LOS ANGELES 28, CALIF. 7046 Hollywood Blvd.	**DALLAS, TEXAS** 313 Fidelity Union Life Building	**PHILADELPHIA 7, PENNA.** 725 Widener Building	**DAYTON 2, OHIO** 410 West First Street
DETROIT 2, MICHIGAN 311 Curtis Building	**NEW YORK 16, N. Y.** 280 Madison Avenue	**CHICAGO 11, ILLINOIS** 520 N. Michigan Ave.	**CLEVELAND 15, OHIO** 811 Hanna Building

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER — *Headquarters for* **VIBRATION CONTROL**

DEPENDABILITY IN 2 LETTERS



TOP

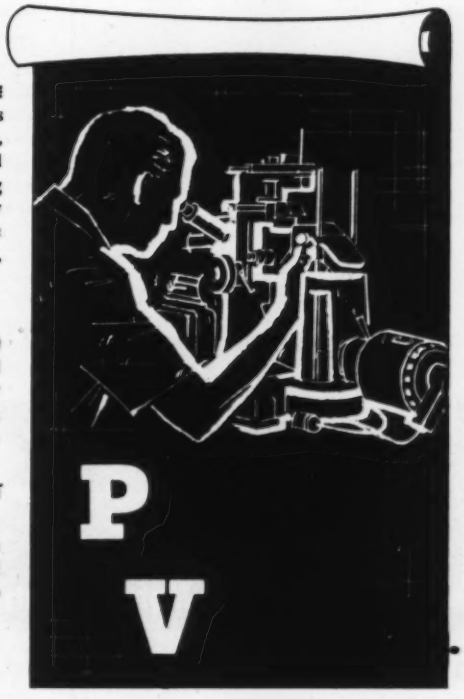
BRONZE "W.S." FULL FLOW GLOBE VALVE *(Fig. 2608)* For 200 pounds W.P. Regrindable, renewable, hardened stainless steel seat and disc. Nominal pipe size opening through seat permits fuller flow with pressure drop and turbulence cut to minimum. Sizes, ⅛" to 3", inclusive.

LEFT

CAST STEEL GATE VALVE *(Fig. 1503)* 150 pounds. Flanged ends, bolted flanged bonnet with outside screw rising stem and yoke. Solid wedge. Available in sizes 1" to 24", inclusive.

RIGHT

"MODEL STAR" GATE VALVE *(Fig. 1793)* For 125 pounds W.P. Iron body, bronze mounted. Supplied with taper solid wedge. Sizes 2" to 30", inclusive.



The life of a valve bears a certain relation to the life of the company that produces it. Powell has had a solid, oak-like growth for over a hundred years. That's only possible because The William Powell Company makes dependable valves.

Today, Powell Valves are proving their dependability in a greater variety of installations than any other valves in the world. And Powell is very likely the leader in research as well as development of special valves to overcome flow control problem situations.

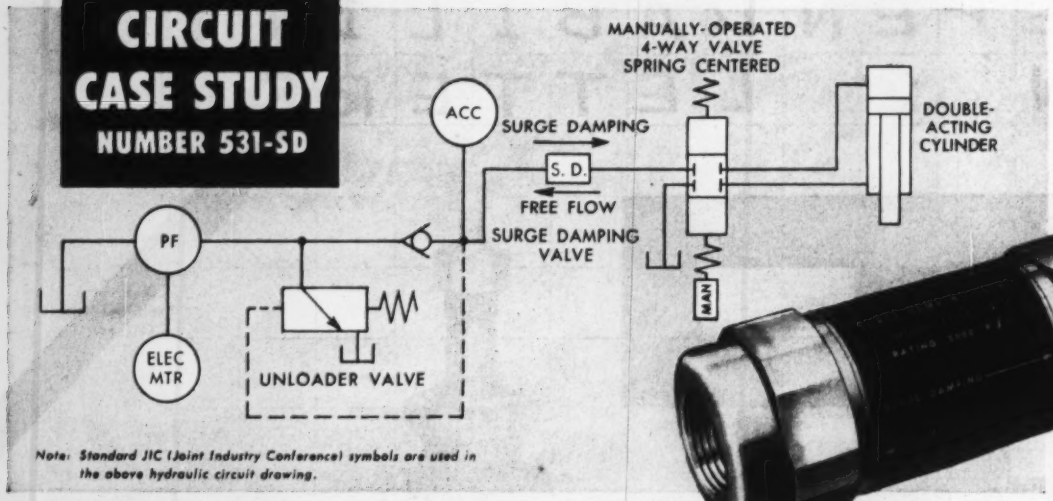
All good reasons why PV, for Powell Valves, appears on more specifications year after year.

THE WILLIAM POWELL COMPANY
CINCINNATI 22, OHIO

CONTROLS FOR THE LIFE LINES OF INDUSTRY

..... 108th YEAR

CIRCUIT CASE STUDY NUMBER 531-SD



Note: Standard JIC (Joint Industry Conference) symbols are used in the above hydraulic circuit drawing.

½ ACTUAL SIZE

DENISON Surge-Damping Valve

prevents destructive, noisy *shock* in hydraulic systems

Fast operating at pressures up to 5000 psi without loss of cycle time

The circuit above shows a typical way to provide for intermittent ram action.

A relatively small pump is used, as reserve pressure is stored in the accumulator between applications of ram effort. When pressure in the accumulator reaches a preset maximum, the unloader valve diverts pump volume to the reservoir at negligible pressure.

Shifting the control of the four-way valve causes the ram to descend on the work, instantly utilizing reserve pressure from the accumulator. Ordinarily, this sudden extra volume and pressure produces hydraulic shock, which causes excessive noise and is apt to damage piping joints and seals.

The Denison **Surge Damping Valve** *prevents*, rather than absorbs, this hydraulic shock. It is a normally closed valve, but when line pressure is directed toward the inlet side, it allows a gradually increased flow of oil until fully opened. Then virtually free flow is maintained until oil flow is interrupted—no matter how briefly. The valve then resets instantly, ready for the next ram action.

Operation is simple and positive. The valve body houses a close-fitting spool which must move against and displace a cushion of oil to permit flow through the valve. As the surge of pressure strikes the spool, oil in the cushion escapes through a small orifice. Oil rushing out of this orifice is directed against a normally open flow control device. This flow control is hydraulically unbalanced; therefore, it tends to close under this pressure—the higher the surge pressure, the greater the throttling effect. In other words, speed of valve opening is inversely related to surge pressure increase.

Even under heaviest shock pressures, the valve takes only a split-second to act. In fact, tests prove it takes no longer to act than the duration of an uncontrolled shock impulse.

Denison **Surge Damping Valves** are made in both industrial and aircraft types, for pressures to 5000 psi. They require no adjustments of any kind, need no maintenance, have no moving seals, adjust automatically to any working pressure in any type of circuit, and do not interfere with other circuit functions. An integral check device provides free reverse flow.

The highly compact and efficient ***Surge Damping Valve*** *(the largest is shown above, one-half actual size) is typical of the complete line of Denison's oil-hydraulic components for circuit pressures to 5000 psi. Wherever the advantages of oil hydraulic equipment can be applied, you can be sure of best results, longest service, and less maintenance when you insist on Denison HydrOlLic Equipment. Let us give you full information on hydraulic equipment for any need. Request Bulletin 146; there's no obligation.*

The DENISON Engineering Company, 1189 Dublin Road, Columbus 16, Ohio

PHYSICS . . In one easy lesson

or why *LEVERAGE* is a good invention

Reprinted from the No. 3, 1948, issue of the Armstrong Trap Magazine

A BURLY giant, whom we shall call Dullbottom for lack of a more descriptive name, was amusing himself in the Petrified Forest one warm July afternoon. Entranced by the many colorful and giant-sized playthings there, he was happily engaged in rolling petrified logs down a small incline when one toppled onto his toe. Despite his most persistent efforts he was unable to dislodge this log, later calculated by Unimpeachable Authorities to weigh 1,000 lbs.

Dullbottom's gruntings and groanings attracted a petite and pretty Physics teacher who (fortunately for our story) was strolling in the vicinity. It took her but a glance to grasp the situation and, without hesitation, she obtained a crowbar from a convenient source of supply, applied LEVERAGE to the log and freed the giant's giant toe.

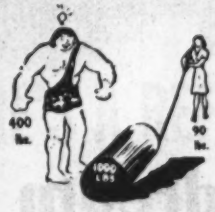
Completely befuddled by the powers of his 90 lb. benefactor, but clumsily grateful, he asked to feel her muscle, a request which was instantly refused. Instead, the young lady offered to explain the fundamentals of LEVERAGE. Delighted by her explanation, that given sufficient LEVERAGE, she could move any weight, Dullbottom immediately proceeded to roll a 4,000 lb. petrified log onto his other foot.

With the infinite patience acquired from dealing with adolescents in the classroom, our pretty Miss obligingly procured another crowbar four times as long as the first and proceeded to move the weight—BUT, much to the dismay of Dullbottom, only ¼ as far, which was, sad to relate, not far enough to free his toe.

And, thereby, hangs a tale. Let's use this little flight of fantasy to explain a fundamental reason why Armstrong steam traps have such large capacity for their size. Please refer to diagrams on the blackboard.

The Fairy Story

1. All Brawn . . . No Brains



2. Science to the Rescue

3. Stupidity Triumphant

No Leverage

To open a 1-1/16" orifice at 15 psi, a steam trap without leverage would require a bucket weighing 19-1/2 lbs. and displacing 29-1/4 lbs. of water. A trap big enough to hold this bucket would weigh somewhere near 300 lbs. At 250 psi, the largest orifice this trap could open would be 9/32".

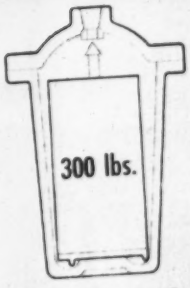
Correct Leverage

Contrast the No-Lever Trap with an Armstrong No. 216 weighing about 1/4 as much . . . 80 lbs. It also opens a 1-1/16" orifice at 15 psi and will open a 3/8" orifice wide at 250 psi — nearly 80% greater than that of the No-Lever Trap. Result of CORRECT LEVERAGE: less weight, less radiation, lower price trap, less installation cost, greater capacity.

Too Much Leverage

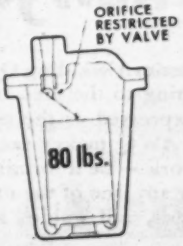
Here's an 80 lb. trap with leverage double that of the No. 216 Armstrong described above. It will open an appreciably larger orifice at any given pressure than the standard Armstrong No. 216. *But, it won't open the valve wide!* There isn't room to get the valve completely away from its seat. Flow through the orifice is thereby restricted and capacity is reduced below that of the No. 216. The larger orifice and the greater leverage is a total loss! To get the valve wide open would require a bigger trap.

The Real Thing



Get Results . . . But Impractical

Efficiency, Economy



Misapplied Science

ARMSTRONG MACHINE WORKS
894 Maple Street
Three Rivers, Michigan

Send for Catalog

Size for Size, Armstrongs have greater capacity because the correct application of high leverage permits the full opening of a large orifice!

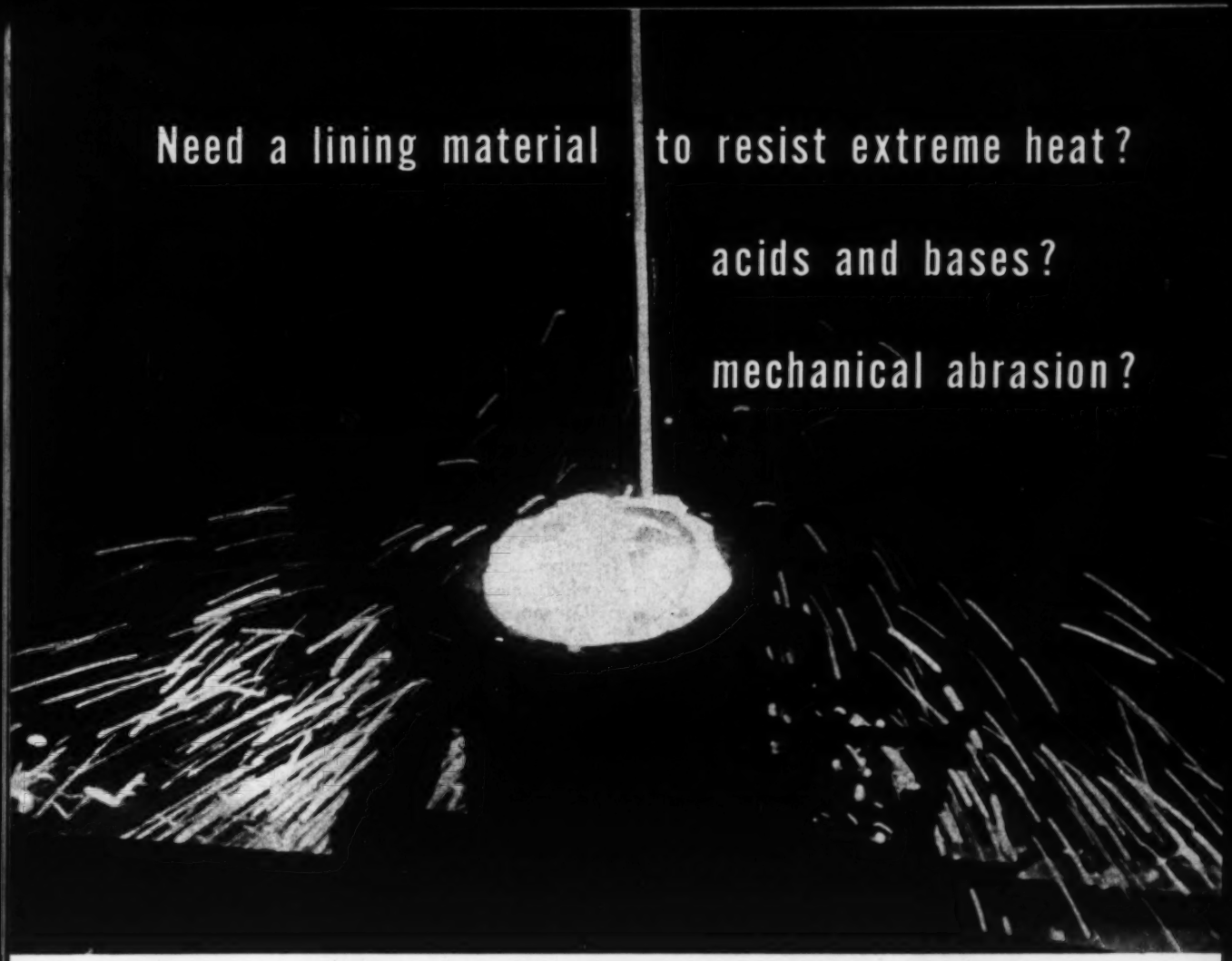
ARMSTRONG STEAM TRAPS

...more than just a pipe dream

AWQ, symbol — American Welding Quality is a very real — and a very serious thing to the men in our shop. Perhaps AWQ can best be expressed as the pride these craftsmen have in their work. AWQ makes each man a critical inspector of his own work — be it forming, welding, machining, assembling — or any one of the other jobs involved in producing rings, bands, and welded assemblies.

For complete welding and machining facilities backed up by conscientious craftsmanship and know-how gained from supplying all types of weldments to American Industry — write us today. Our Product Development Division will be glad to apply 35 years of experience to the study of your particular problem.

THE AMERICAN WELDING & MANUFACTURING COMPANY • 470 DIETZ ROAD WARREN • OHIO



HERE'S A REFRACTORY THAT'S CAST— LIKE A METAL

It's pure cast alumina . . . very hard, very inert, very nearly impermeable.

And, we might add, very nearly indestructible. This molten stream is over 98% alumina. As it cools, it will form tightly interlocked alpha and beta alumina crystals. This makes a hard, ivory-like structure... with the inherent stability of pure alumina . . . in a dense, nearly impermeable body.

It takes a temperature of 3600 F to melt this refractory. The castings are so hard (hard enough to cut glass like a diamond) that they outwear metals. And so pure that the traces of impurities total less than 0.07%—a consideration if contamination is a factor.

This material has proved itself under the severest conditions. It has tremendous resistance to slags—*both basic and acid*. It's ideal for use in glass melting tanks, where there's extreme heat, corrosive fumes, and a molten bath that has a huge appetite for linings. It's used for wear-resistant applications in the steel industry. There are corrosion-resistant applications in process industries, etc.

WHY NOT CHECK UP? There must be scores of undiscovered uses for this comparative newcomer in the refractory field—and yours may be one. It bears investigating. Use the handy coupon below.

CARBORUNDUM
Registered Trade Mark

Dept. P-24, Refractories Division
The Carborundum Co., Perth Amboy, N. J.

☐ As a starter, send literature only.

☐ I'd like to see this cast alumina. Phone first, for convenient appointment.

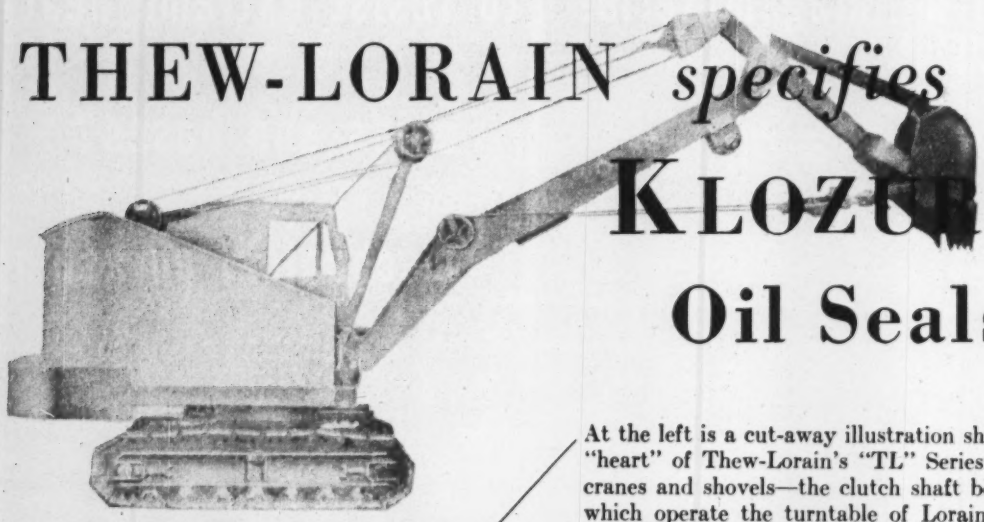
NAME _____ POSITION _____

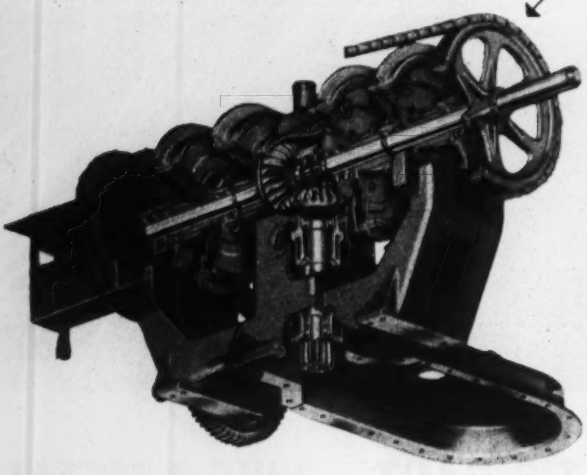
COMPANY _____

ADDRESS _____

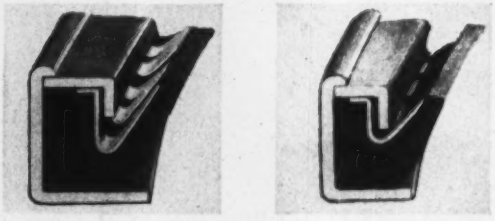
For positive bearing protection

THEW-LORAIN *specifies* KLOZURE* Oil Seals





At the left is a cut-away illustration showing the "heart" of Thew-Lorain's "TL" Series of power cranes and shovels—the clutch shaft bevel gears which operate the turntable of Lorain TL-25's. Dependable KLOZURES protect 5 of the clutch shaft bearings under the most rugged service conditions where operating temperatures often exceed 250° F.



MODEL 53 KLOZURE **MODEL 51 KLOZURE**

Cross-sectional views of finger-spring KLOZURES; hycar sealing element for normal services—silicone rubber sealing element for elevated temperatures.

Thew-Lorain power shovels and cranes must withstand rugged operating conditions—where dust, dirt, and moisture are the rule rather than the exception. That's why TL engineers specify dependable KLOZURE Oil Seals for the inner clutch assembly (illustrated) and many other bearing applications. These superior oil seals give maximum bearing protection by keeping the lubricant *in*, dirt and moisture *out*.

Prolong the life of your bearings! Standardize on Garlock KLOZURES and prevent breakdowns and resulting losses in production.

KLOZURE Oil Seals are made in a complete range of sizes and in many models. For full information call your Garlock representative or write for KLOZURE Catalog No. 10.

THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK

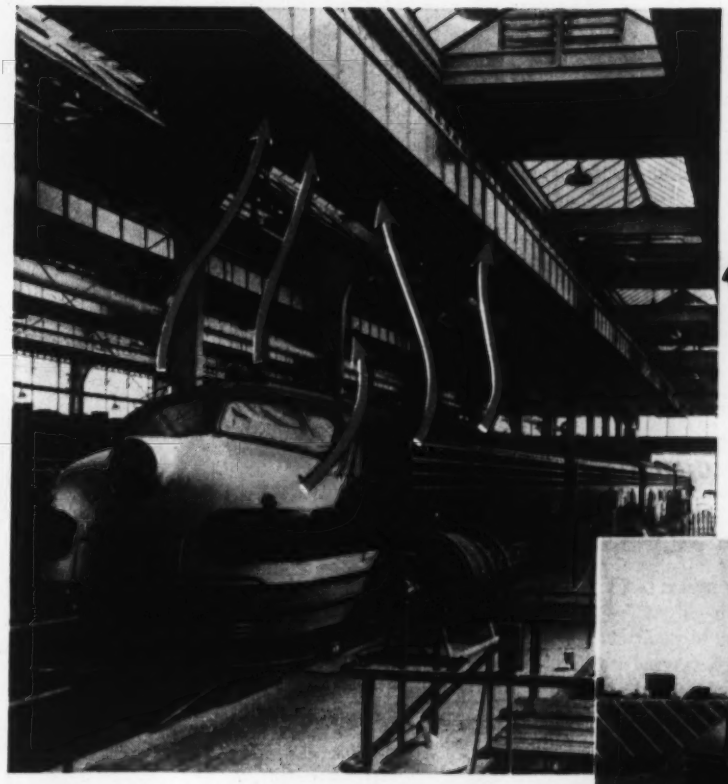
Sales Offices and Warehouses: Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland • Denver Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N. Y.) • Philadelphia • Pittsburgh • Portland (Ore.) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

In Canada: The Garlock Packing Company of Canada Ltd., Toronto, Ont.

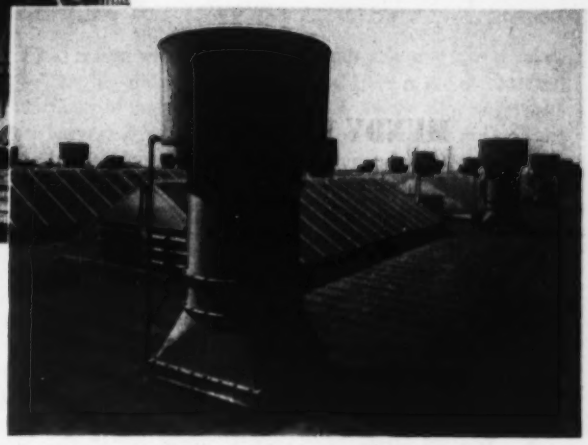
*Registered Trademark

GARLOCK

PACKINGS, GASKETS, OIL SEALS, MECHANICAL SEALS, RUBBER EXPANSION JOINTS



DEODORIZING DIESELS



HOW SOUTHERN PACIFIC VENTILATED ITS ROSEVILLE ROUNDHOUSE WITH JOY AXIVANE® FANS

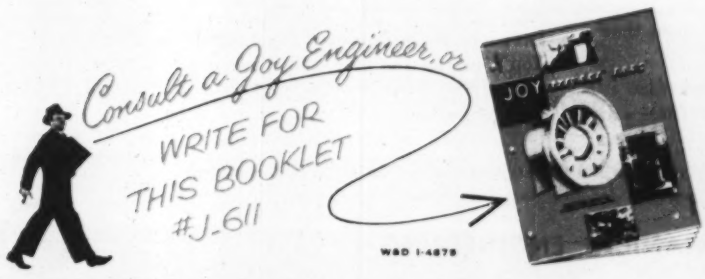
When in need of servicing, the diesel locomotives of Southern Pacific are driven into the roundhouse and parked under long ceiling hoods. As the engines are raced or idled, the customary fumes are emitted from the exhaust. BUT, you have to sniff hard to catch even a faint whiff of diesel fumes in the roundhouse!

HOW'S IT DONE? By Joy Axivane Fans, of course. Thirty-six fans are hidden in the ceiling hoods. The exhaust gases are hustled out—at the rate of 726,000 CFM—before they can contaminate the surrounding air.

TOPS IN EFFICIENCY. Six 1½ HP models handle 11,000 CFM each, while thirty 5 HP models handle 22,000 CFM each. The fans are actually located right in the exhaust ducts—not an inch of valuable room space is sacrificed!

HIGH-TEMPERATURE PROBLEM, TOO. The air being exhausted sometimes reaches a temperature of 280° F., but temperature variations have little effect on these fans. The vaneaxial design, with adjustable blades, packs plenty of punch—under all conditions. The in-line construction and in-the-duct installation . . . possible only with this type of fan . . . make for real space savings.

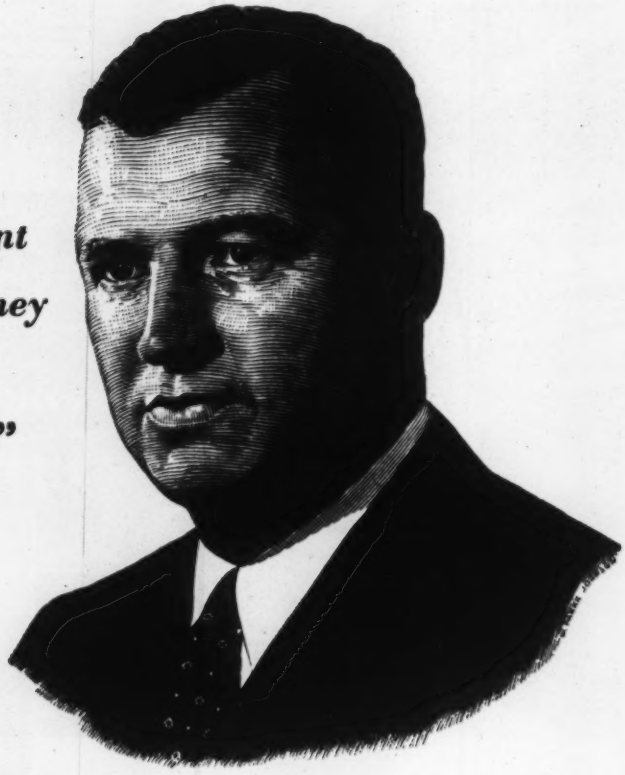
136 MODELS. The Joy Axivane Fan line is a wide one. Capacities range up to 200,000 CFM and pressures top 11" wg. Some models will nestle in the palm of your hand while others would dwarf your home. Want the whole story? Write for our Bulletin J-611, TODAY. ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.,*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*



JOY

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1853

"Wise public debt management with its goal of sound money is of prime concern to every American."



MUNDY I. PEALE
President
Republic Aviation Corporation

"Wise public debt management with its goal of sound money is of prime concern to every American. Regular purchase of U. S. Savings Bonds contributes importantly to the achievement of this objective and, at the same time, helps assure our future security, individually and as a nation. We at Republic Aviation feel a deep sense of pride in the knowledge that 94% of all our employees became investors as a result of our most recent campaign and that $631,000 in bonds are purchased each month on our automatic Payroll Savings Plan."

Perhaps the importance of U. S. Savings Bonds and the Payroll Savings Plan as factors in wise debt management and the achievement of sound money may not have occurred to you.

Here are a few facts and figures:

• For every dollar of public debt held by a commercial bank, about five new dollars may be created in the form of credit. Obviously, the larger the amount of the public debt held by individuals, the greater the check on inflationary tendencies.

• At the end of 1953, the cash value of Series E and H Bonds *held* by individuals was more than 36 billion dollars. This total is growing steadily, thanks largely to the month after month purchases of Series E Bonds by more than 8,000,000 Payroll Savers.

• Sales of E and H Bonds in 1953—23% higher than in 1952—provided cash for *all* E and H Bond maturities and redemptions and still left over $210,000,000 *net* for the reduction of bank-held debt.

• The ownership of more than $36,000,000,000 in Savings Bonds by millions of Americans constitutes a reservoir of future purchasing power—an asset to industry and business as well as to the individuals who built it by their Bond-conscious thrift.

Why not team up with Mr. Peale and other leaders of industry in their efforts to help America reach its goal of wise public debt management and sound money? All you have to do is (1) show a *personal* interest in your Payroll Savings Plan. Get the figures on the percentage of employee participation and the amount of monthly savings by your employees. (2) Wire, phone or write to Savings Bond Division, U. S. Treasury Department, Washington, D. C. You'll get all the help you need to build up or install a Payroll Savings Plan that will reflect your company and its interest in America.

The United States Government does not pay for this advertising. The Treasury Department thanks, for their patriotic donation, the Advertising Council and

MECHANICAL ENGINEERING

We help feed 1 million babies every day!

From field to container, Gerber's baby foods receive fast, sanitary handling on Link-Belt equipment

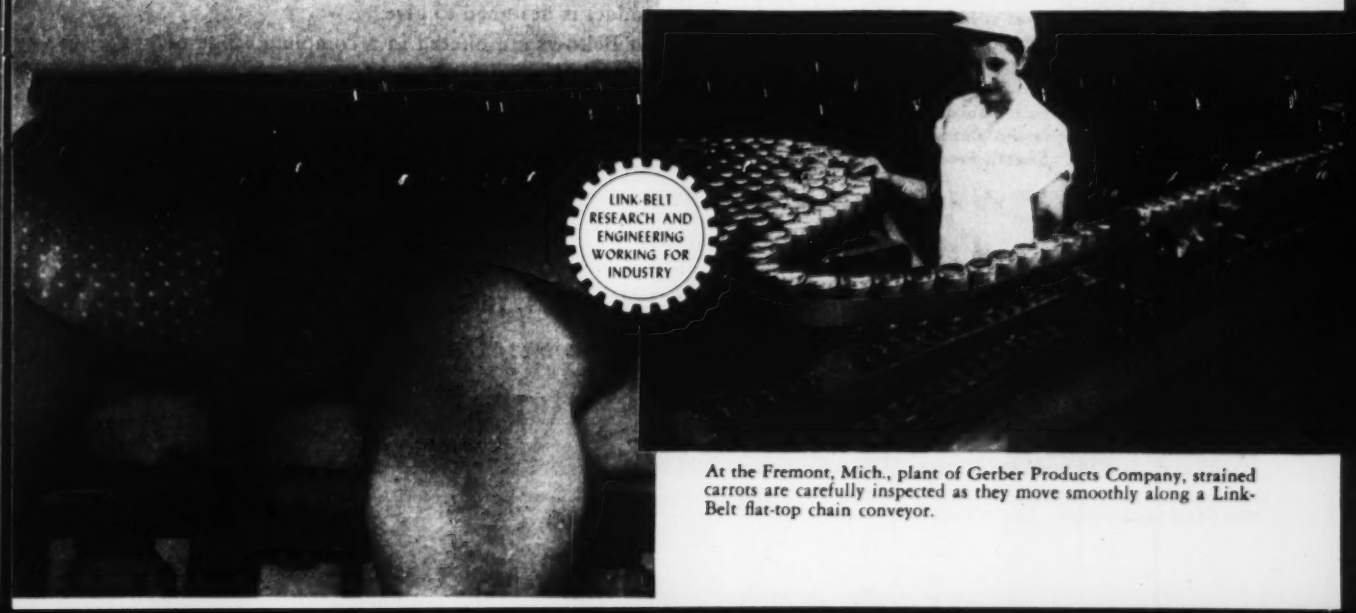
BIG reason why Gerber's baby foods cost only half as much as they did when introduced in 1928 is the mechanized efficiency of mass production. And, from the time vegetables are harvested in the fields . . . until the containers are shipped —Link-Belt conveying and power transmission products find wide use in the four modern Gerber plants.

Not only the food you eat—but also almost everything you use in daily living—is produced with the help of Link-Belt. If you have a problem involving the movement of materials or the transmission of power, you can get the answer to your complete needs by calling the Link-Belt office or distributor near you.

LINK-BELT

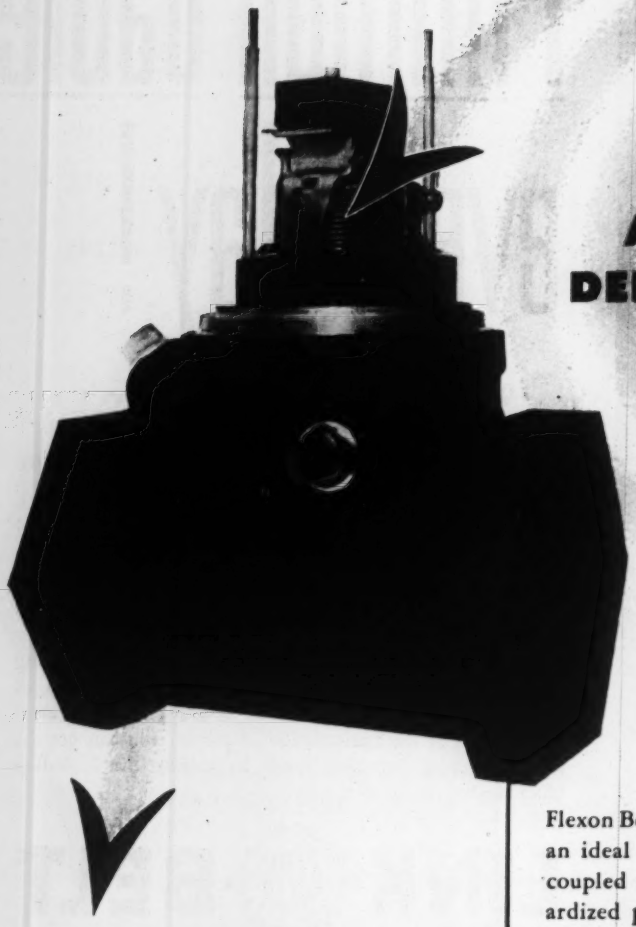
One source . . . one responsibility for materials handling and power transmission machinery

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office: New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13,203



At the Fremont, Mich., plant of Gerber Products Company, strained carrots are carefully inspected as they move smoothly along a Link-Belt flat-top chain conveyor.

THIS FLEXON BELLOWS ASSURES PRECISE, DEPENDABLE CONTROL WITH THIS FLOW SWITCH!



Thermostatically controlled flow switch manufactured by Power Engineering & Equipment Co. which incorporates a ¾" I.D. Flexon Bellows.

Flexon Bellows offer the designer and the manufacturer an ideal combination—high standards of uniformity coupled with the manufacturing economies of standardized production. In over fifteen years of bellows manufacture, Flexonics Corporation has developed manufacturing techniques that permit the fabrication of a wide variety of bellows as standard production items. Using these methods assures exact compliance with your specifications . . . assures you that the Flexon Bellows will "fit" your product to avoid assembly headaches . . . assures you of the type of performance your product is designed to give.

Flexon Bellows are offered in a complete range of sizes in brass, bronze, stainless steel, monel and other alloys. For any thermostatically controlled device, it will pay for you to consider Flexon. For recommendations send an outline of your requirements.

Here are the answers to many BELLOWS APPLICATION PROBLEMS

The Flexon Bellows Design Guide, Bulletin No. 113, gives specifications and application data on Flexon Bellows. Write for your copy of this helpful booklet or see Flexon Bellows specifications in the Flexonics Catalog in Sweet's Product Design File.

Flexonics Corporation 1305 S. THIRD AVENUE • MAYWOOD, ILLINOIS

FLEXON BELLOWS DIVISION

FORMERLY CHICAGO METAL HOSE CORPORATION

In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

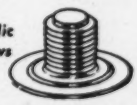
Flexon identifies products of Flexonics Corporation that have served industry for over 50 years.

Flexible metal hose

Expansion joints

Aircraft components

Metallic bellows



260-point, newly designed, run-out table at Allegheny Ludlum, automatically lubricated by Trabon.

11 bearings on the revolving mandrel of this Allegheny Ludlum coiler are quickly and easily lubricated by Trabon.

Trabon

LUBRICATES 3800 BEARING POINTS AT ALLEGHENY LUDLUM PLANTS IN PITTSBURGH DISTRICT

this has a BEARING on the subject

Here at one of the country's leading steel companies is a good example of dependable, versatile TRABON automatic lubrication at work. 3800 points on a wide variety of equipment . . . hot strip mill, cold tandem mills, soaking pits, furnaces . . . are being lubricated by Trabon systems.

There are good reasons for Allegheny Ludlum's choice of Trabon automatic lubrication systems:

- Trabon engineering service assures the best in design, fabrication and installation.
- It's a *positive* system—a single indicator at the pump to tell the operator when all bearings have been lubricated.
- It's completely sealed so that it operates effectively even underground and is unaffected by steam, dirt or snow.
- Trabon systems, for either oil or grease, fit any bearing situation.

Write for more information today.

Trabon ENGINEERING CORPORATION
1814 E. 40th STREET • CLEVELAND 3, OHIO
Oil and Grease Systems

ANACONDA® METALS AT WORK

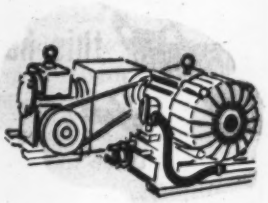
Copper "package" for the coldest products on earth

This container for storing and transporting liquefied helium (—452 F.) or hydrogen (—421 F.) is made by Superior Air Products Co. of Newark, N. J. The secret of keeping heat out to reduce evaporation is four concentric copper spheres separated by a high-vacuum space, a nitrogen protecting bath, and a second high-vacuum space — the entire unit enclosed in a stainless steel casing. Copper contributes ductility and malleability for spinning into hemispheres, unexcelled soldering properties for joining into spheres, and a mirror finish to reduce radiation losses. Need we tell you that it's made of ANACONDA Copper?

This "iron horse" runs on brass

The "High Iron" we're referring to is the HOBBYLINE HO-GAGE model railroad track which John A. English & Co. of Morrisville, Pa., makes of FORMBRITE** strip. This fine-grain, yet ductile forming brass produces a track so strong and stiff it will support an adult's weight. In products where finishing costs count, users find that FORMBRITE usually needs only a color buff to produce a high finish.

Flexible conduit enjoys a splash in a bath



The real trick is to make an electrical conduit that's flexible *and* liquid-tight *and* approved by Underwriters' Laboratories for such applications. SEALTITE* Type UA does all three. Made with a tough synthetic jacket extruded over a flexible steel core, it's shown here protecting wiring to motor in an auto laundry. It ignores not only splashing, but also oil and grease, and resists abrasion. Want more facts?

We put an end to "the bends"

We don't mean the kind deep-sea divers suffer from, but the kind heating contractors had to put up with when they installed radiant panel heating systems. Heretofore, many contractors formed the panel grids on the job by hand-bending them from coils of tubing—a time-consuming, laborious, back-breaking job. Now PG's** have ended all that. They are the new, compactly packaged, accurately *preformed* ANACONDA Copper Tube Panel Grids . . . from the handy carton to installation is only a matter of minutes. PG's are another ANACONDA first.

A service for you

Our Technical Department has a range of experience that covers the entire field of copper and copper-alloy applications in industry. If you have a problem of metal selection, we are at your service. *The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.*

*Trademark
**Reg. U.S. Pat. Off. 8393

ANACONDA® *the name to remember in* **COPPER — BRASS — BRONZE**

Small Tools and Machine Tool Elements

AMERICAN STANDARDS PUBLISHED BY THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS, 29 W. 39 ST., N. Y. 18

ACCURACY OF ENGINE AND TOOL ROOM LATHES, B5.16—1952. $1.00

Gives the tolerances to which industry is building 12 in. to 18 in., 20 in. to 32 in., and 40 in. to 72 in. lathes and the tests for determining the accuracy of the lathes.

ADJUSTABLE ADAPTERS, B5.11—1937. 60¢

This standard gives the general dimensions of assembly, detail dimensions for adjustable adapter body, and general dimensions for adjustable adapter nuts, specifications for material finish, marking, and tolerances.

CHUCKS AND CHUCK JAWS, B5.8—1936. 55¢

Establishes controlling dimensions for all chucks from 6-in. to 36-in. diameter of both medium and heavy duty types, for an extra heavy series of chucks with serrated master jaws, for power-operated and hand-operated chucks of two-, three-, and four-jaw types.

CIRCULAR AND DOVETAILED FORMING TOOL BLANKS, B5.7—1948. 75¢

The 62 types of machines for which tool blanks and holders are provided are classified into six different groups of comparable stock capacities. Dimensions are given in this Standard for (a) circular tools with threaded mounting hole for groups 1, 2, and 3, (b) circular tools with counter-bored mounting hole for groups 4, 5, and 6, (c) dovetailed tools for all six groups, and (d) circular forming and dovetailed tool holders for all six groups.

DRILL DRIVERS (Split-Sleeve, Collet-Type), B5.27—1951 50¢

This Standard gives taper dimensions, general specifications, and the dimensions for 135 sizes of drill drivers along with the standard and optional taper number for each size.

INVOLUTE SPLINES, B5.15—1950. $2.00

Tables give dimensional and effective clearances, minor diameter fits, dimensions for both the flat root and fillet root types, basic measurements between and over pins, special pin measurements, and hob and broach dimensions. Provisions are made for allowable errors. Formulas are given for calculating pin measurements and torque capacities.

INVOLUTE SERRATIONS, B5.26—1950. $1.00

Presents a uniform, easily fabricated set of serrations. The pitches included are 10/20, 16/32, 24/48, 32/64, 40/80, 48/96, 64/128, 80/160, 128/256 complete from 6 to 100 teeth only for the first three. The Standard makes provisions for allowable errors and effective fits, and includes the basic measurements between and over pins, also tables of maximum tooth space and minimum tooth thickness.

INVOLUTE SPLINE AND SERRATION GAGES AND GAGING, B5.31—1953 $1.25

Factors affecting fits and their control, working and inspection gages, inspection methods, machining tolerances and allowable errors are among the subjects covered. Tables give gage dimensions and formulas for ring gage pin measurements and for plug, ring and snap gage dimensions.

JIG BUSHINGS, B.56—1941, REAFFIRMED 1949. 50¢

Dimensions for: Press-Fit, Renewable-Wearing and Liner Bushings.

KNURLING, B5.30—1953 $1.00

This standard covers knurling tools with standardized diametral pitches and includes dimensional relations with stock in the production of straight, diagonal and diamond knurling on cylindrical surfaces having teeth of uniform pitch parallel to the axis of the cylinder or at a helix angle not exceeding 45 deg with axis of work, such knurling being made by the displacement of the material on the surface when rotated under pressure against a knurling tool.

MOUNTING DIMENSIONS OF LUBRICATING AND COOLANT PUMPS FOR MACHINE TOOLS, B5.28—1952 $1.00

Tables give specific mounting dimensions for motor-driven centrifugal pumps, centrifugal and geared pumps, centrifugal pumps, and gear and vane pumps. Dimensions for mounting brackets are also given.

PUNCH AND DIE SETS FOR TWO-POST PUNCH PRESS TOOLS, B5.25—1950. 75¢

These dimensions for back-post and diagonal-post sets cover die area, the die holder and punch holder thickness, shank diameters and lengths, guideposts and bushings, and removable punch holder shanks.

ROTATING AIR CYLINDERS AND ADAPTERS, B5.5—1932, REAFFIRMED 1949. 50¢

These adapters are for cylinders of the following sizes: 3- and 4½-in., 6- and 8-in., 10 to 18 in., and for the 20-in. air cylinder or other power-operated device having a draw rod pull of 26,000 to 40,000 pounds. The length of stroke of the cylinders, the position of the piston rod at the end of the stroke, the diameter of the piston rod, and the size of the tapped hole in the piston rod have also been standardized.

SINGLE-POINT CUTTING TOOLS AND TOOL POSTS, B5.22—1950. $1.25

Standard defines and illustrates the different classes of tools, their parts, and the angles at which they are used. Preferred dimensions are for: tool shanks, tool post openings, and lathe center height for solid tools and tool holders, six styles of sintered carbide tips and the tips and shanks of tipped tools.

MARKINGS FOR GRINDING WHEELS, B5.17—1949. 50¢

Covering markings only, this Standard establishes a symbol for each of the most essential characteristics of a grinding wheel and arranges them in uniform sequence.

SPINDLE NOSES FOR TOOL ROOM LATHES, B5.9—1948. 85¢

These Spindle noses are for use on tool room lathes, engine lathes, turret lathes, and automatic lathes. Dimensions cover each size and type of nose, mating backs of chucks, face plates, and fixtures, and gages for checking important dimension on spindle noses and on back of chucks, face plates, and fixtures. There are instructions for drilling balancing holes for Type A spindle.

20% Discount to ASME Members

SPINDLE NOSES AND ARBORS FOR MILLING MACHINES, B5.18—1953 $1.00

Contains dimensions for ends of arbor and adapter, for spindle nose, and for draw-in bolt end also sketches of selective types of drive key construction.

STRAIGHT CUT-OFF BLADES FOR LATHES AND SCREW MACHINES, B5.21—1949 50¢

Gives dimensions for the height, length, and thickness of the approved four types of blades, and includes sketches to show the optional shapes for cut-off blade stock.

T-SLOTS, THEIR BOLTS, NUTS, TONGUES, AND CUTTERS, B5.1—1949. 50¢

While recommending a width of throat greater than the nominal diameter of the bolt, provisions are made for an alternative standard having the throat width equal to the nominal diameter of the bolt. Other recommendations provide for the use of a stud of a smaller size than the T-bolt for the corresponding slot, that T-bolts, nuts, and slots be known by the diameter of the bolt, and for chamfering corners.

LIFE TESTS OF SINGLE-POINT TOOLS, B5.19—1946. 55¢

These tests apply to speed, feeds, depth of cuts, shape and size of tools, Rockwell hardness, shape and size of test logs, etc.

TWIST DRILLS, B5.12—1950.

Provides dimensions and tolerances for standard straight shank drills varying from 0.0135 to 2.000 in., taper shank drills from ⅛ in. to 3½ in., the corresponding drill lengths and flute lengths.

MACHINE TAPERS, B5.10—1953. $1.00

Presents basic dimensions for 22 sizes of self-holding tapers, detailed dimensions and tolerances for self-holding taper shanks and sockets, for the plug and ring gages applying to this series of tapers, and the dimensions for 12 sizes of steep machine tapers.

MACHINE PINS, B5.20—1947 50¢

These dimensions are for: hardened and ground dowel pins, straight pins, ground dowel pins (not hardened), taper pins, clevis pins, and cotter pins. An appendix gives specifications for taper pins and a drill chart for the size of drill and number required.

MILLING CUTTERS, B5.3—1950. $2.25

Reflecting the developments in cutter design, tool material, and machine improvements are the 56 illustrated types for which dimensions are here given.

REAMERS, B5.14—1949. $1.50

General dimensions of thirty standard types of reamers and related tools are presented along with the magnitude and direction of the tolerances including the number of flutes in the various types.

TAPS—CUT AND GROUND THREADS, B5.4—1948. $1.50

32 tables give the thread and general dimensions together with the working tolerances for nine types of taps. Supplementary material includes terminology and definitions and instructions for marking taps, dies, and other threading tools.

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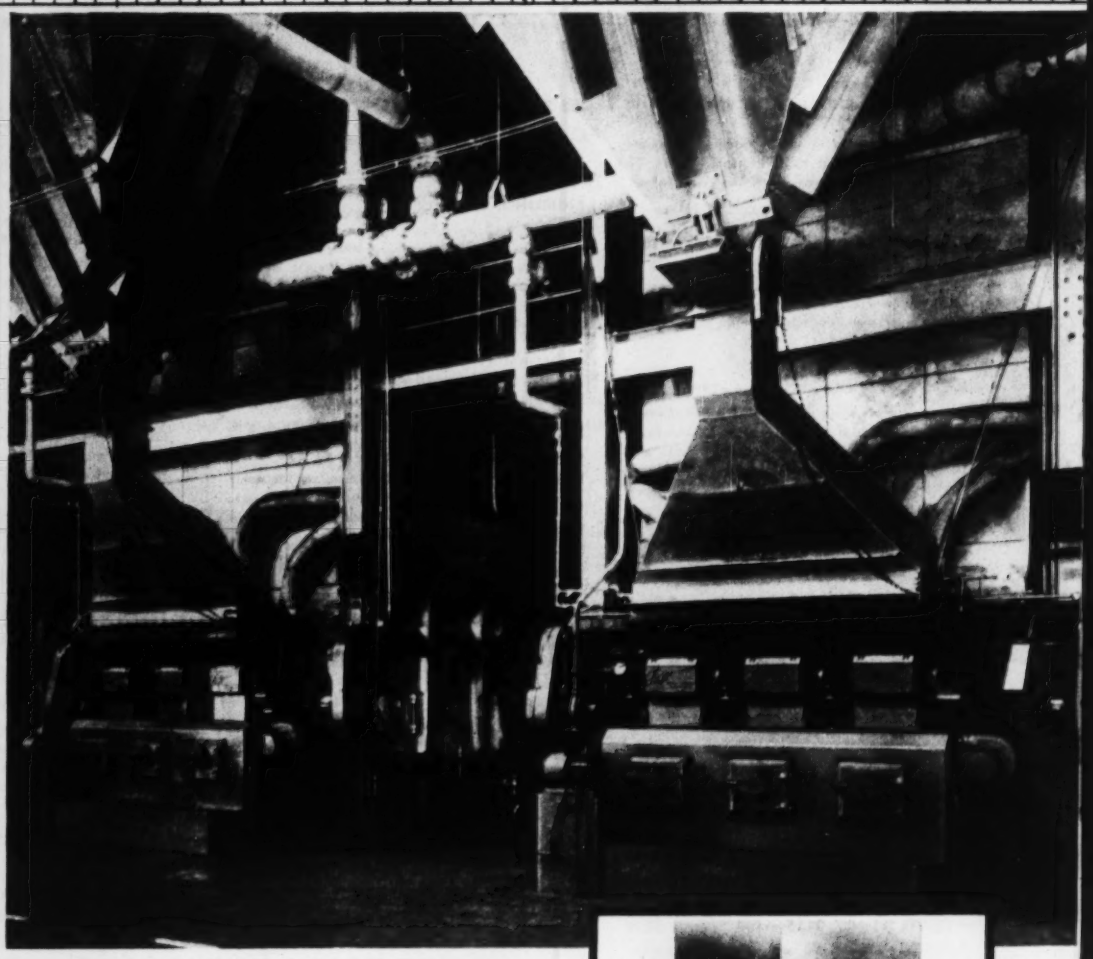
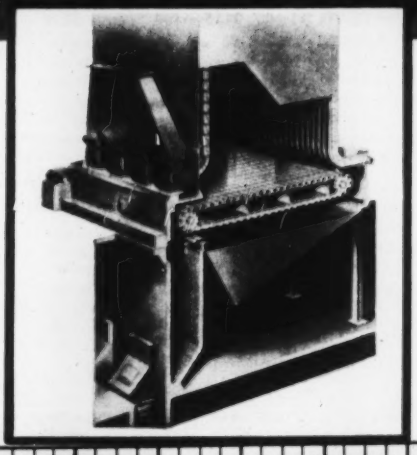


This typical Hoffman installation consists of three 60,000-pound continuous ash discharge stokers. If an emergency occurs, the stokers are proportioned so that any two boilers will carry the normal plant-load of 180,000 pounds of steam.



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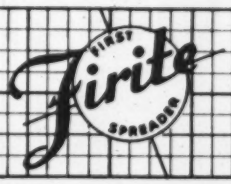

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Hoffman built the first forced draft spreader stoker—still the most respected by thousands of owners.

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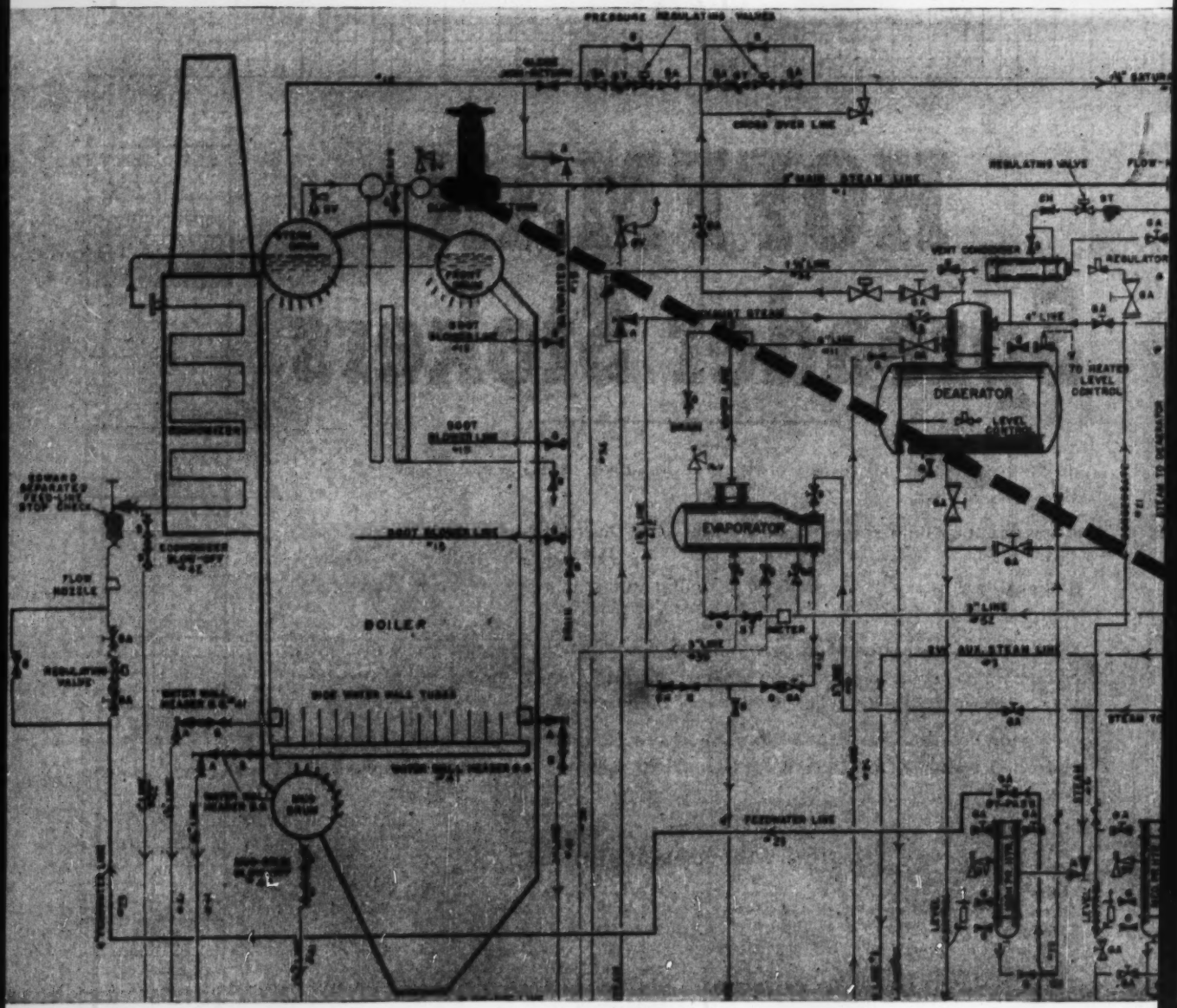


Essential to boiler safety is a non-return valve, required to prevent flow of steam from the main header into a boiler which is temporarily below header pressure. Edward non-return valves are installed on an overwhelming majority of the nation's principal power plant boilers.

BOILER CODE REQUIREMENTS

When two or more boilers are connected to a common header, the steam connection from each boiler must be fitted with two stop valves, preferably consisting of one automatic non-return valve set next to the boiler and a second valve of the outside screw and yoke type.

The non-return valve must be rated:

1 At 100% of the set pressure of the drum safety valve at the corresponding saturated steam temperature.

2 At 100% of the minimum set pressure of the super heater safety valve at the super heated steam temperature.

3 At 85% of the lowest set pressure of the boiler drum safety valve at the expected temperature at the super heater outlet.

Reference P 302, P 303, Rules for Construction of Power Boilers, 1952.

INSTALLATION POINTERS

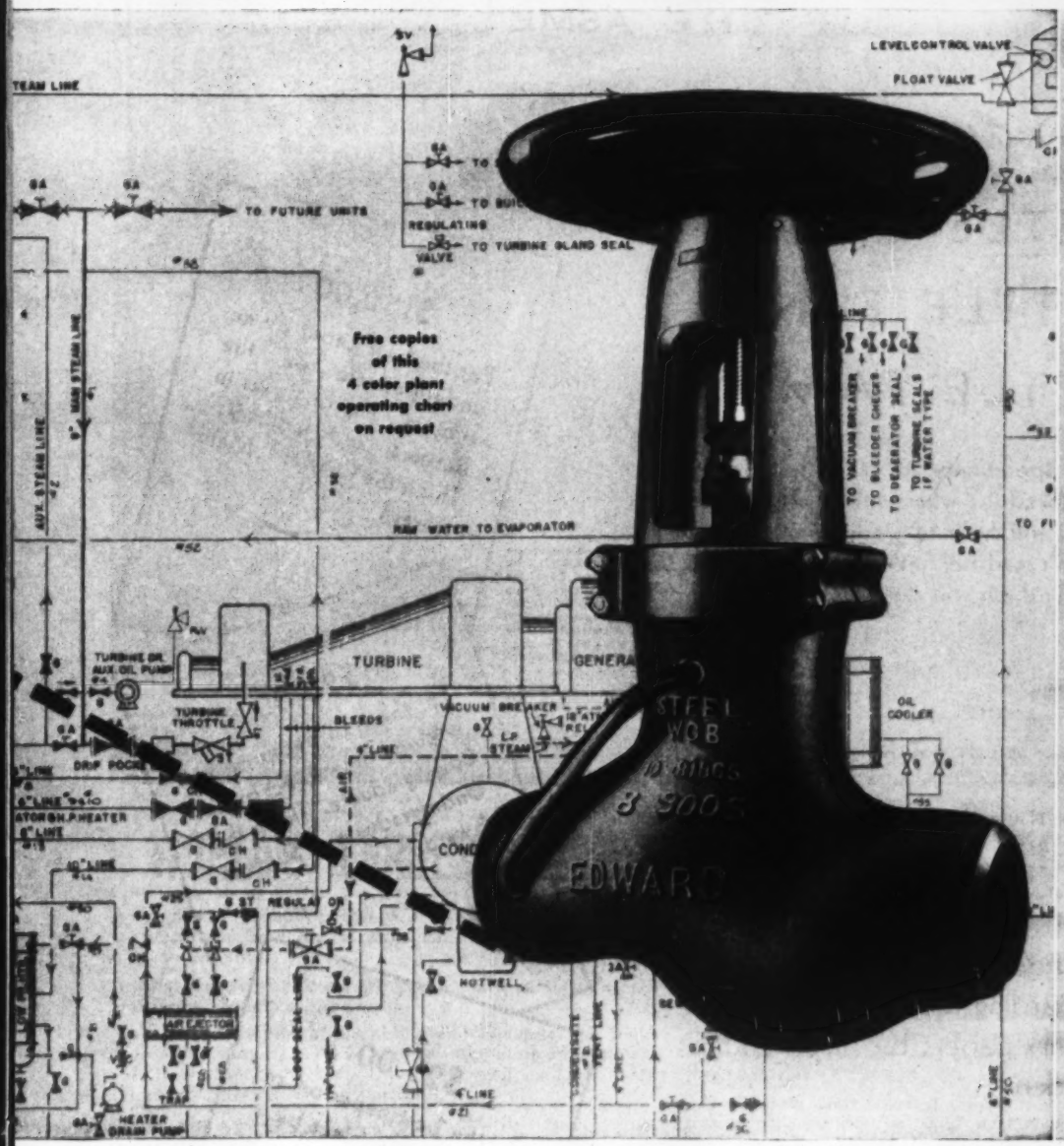
The non-return valve should be installed:

1 So that it can be readily manipulated by hand as a stop valve.

2 So that the disk piston is in a vertical plane. Avoid installations where the disk piston travels on an angle, thus providing the possibility of hang-ups and incomplete closure.

3 With an Equalizer, where operating conditions require wide variations in flow rates. The Equalizer, a piping connection between the high pressure area over the disk piston and the low pressure, high velocity outlet, causes the disk piston to be sucked up into the bonnet chamber, which gives it a firm support and provides vibrationless operation. The flow passages in the valve are left wide open for minimum pressure drop.

NON-RETURN VALVES*



4 On the boiler lead just after the superheater safety valve. An Edward gate valve is recommended as the second stop valve required by the boiler code which also stipulates that a drain must be installed between the two valves so that its discharge is visible while the operator is manipulating the valve.

SELECTION POINTERS

Be sure your non-return valve has:

1 A simple uncomplicated design—avoid gadgety constructions and involved mechanisms which can cause trouble and fail in operation.

2 A closing mechanism which insures drop tight closing at boiler test pressures. A great asset here is the Edward Impactor Handwheel which allows an operator to apply 2.8 times the closing force of ordinary handwheels.

3 Forged stainless steel piston rings. Insistence on forged rings will eliminate disassembling of valve to remove pieces of broken piston rings from the flow passages.

4 Body contours which have been specifically designed and tested for minimum pressure drop.

5 Integrally cast mirror smooth guide ribs, which govern the path of the disk piston during its entire travel. Stem guided disk pistons may cause faulty alignment during the last stages of travel, the most critical part.

6 Light weight disk piston of hourglass design for maximum piston lift and low pressure drop.

For complete information on non-return valves write for a copy of catalog 12-B to Department NR, Edward Valves, 1350 West 145th St., East Chicago, Indiana.

*One of a series providing condensed information on valve applications in steam power plants.

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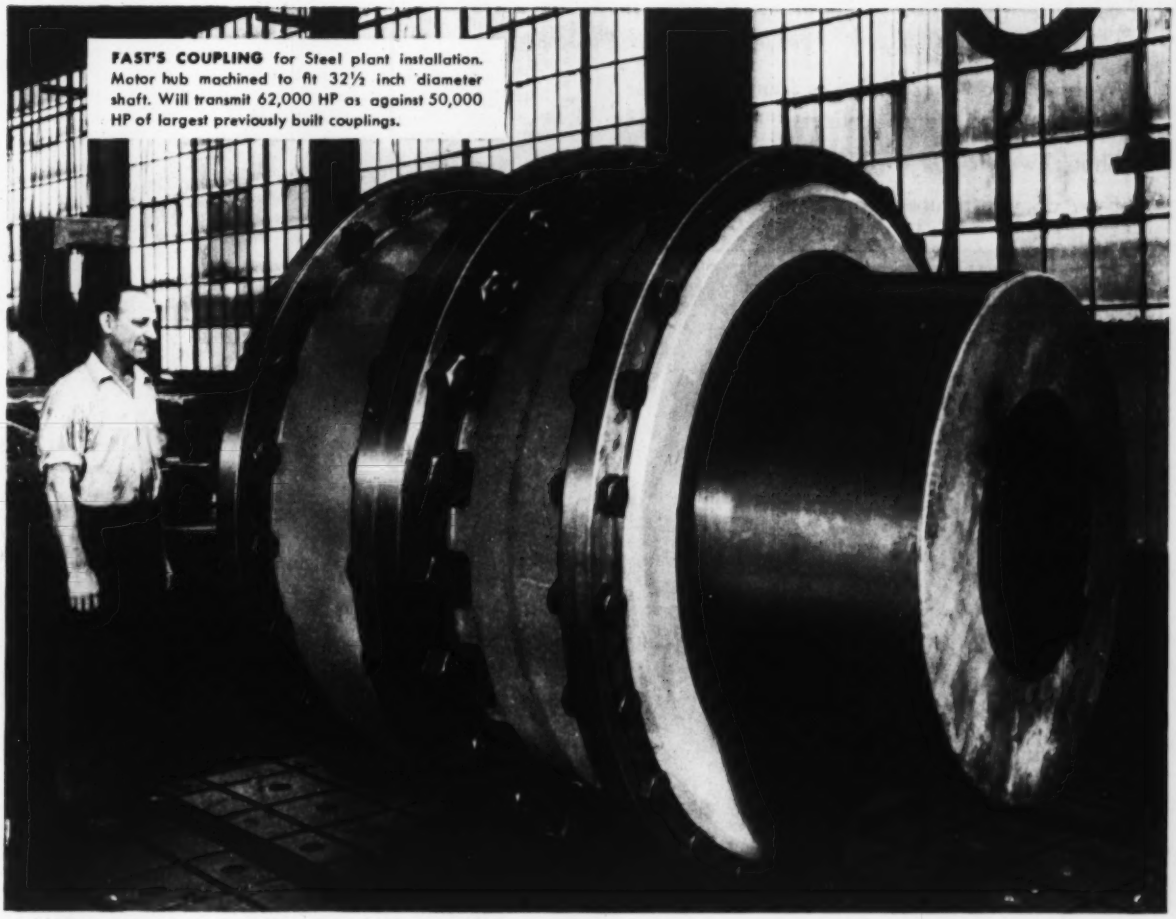

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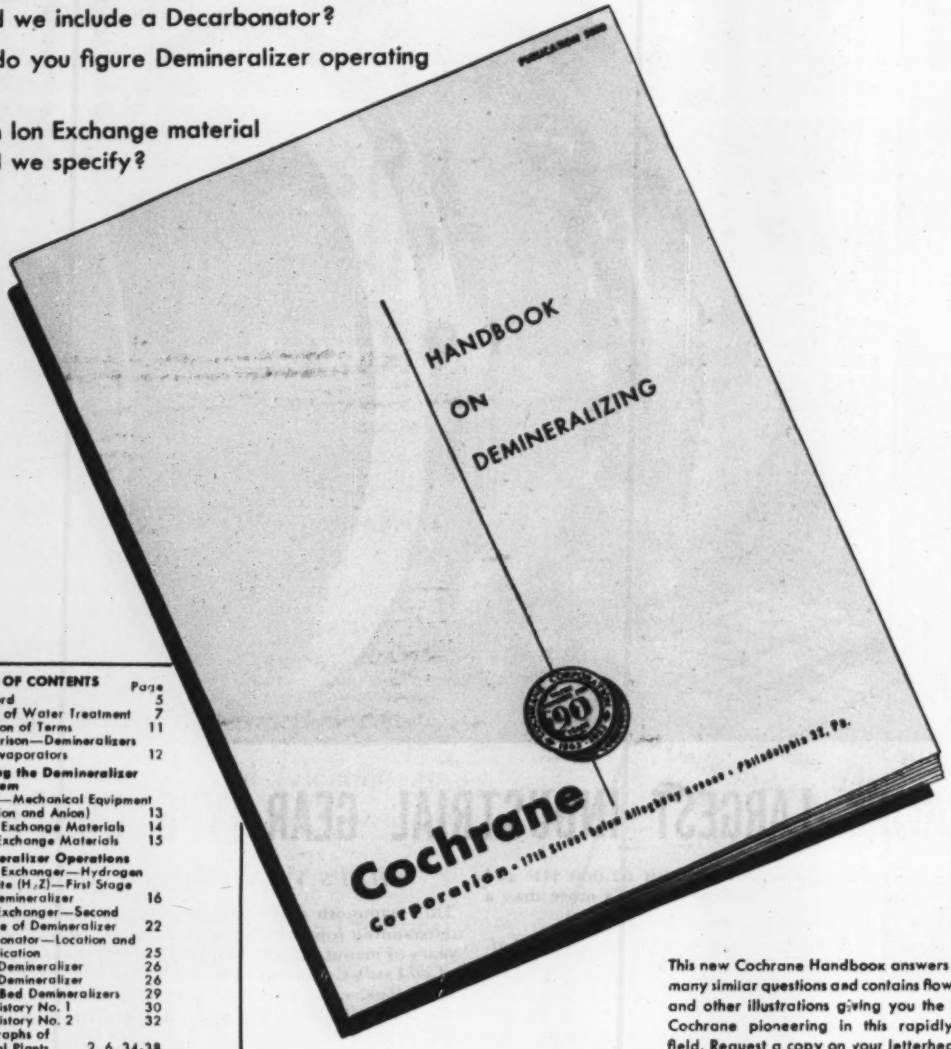

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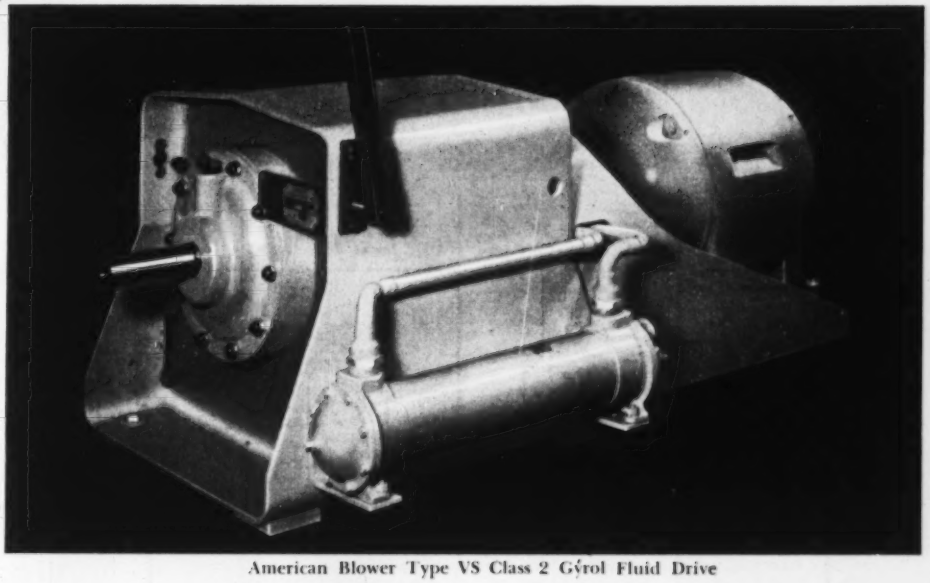

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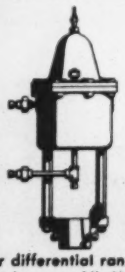

for differential ranges as low as 1" H_2O, especially for low pressure gas and air service.

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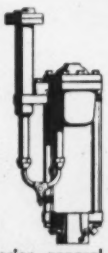

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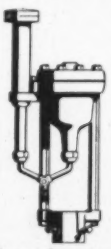

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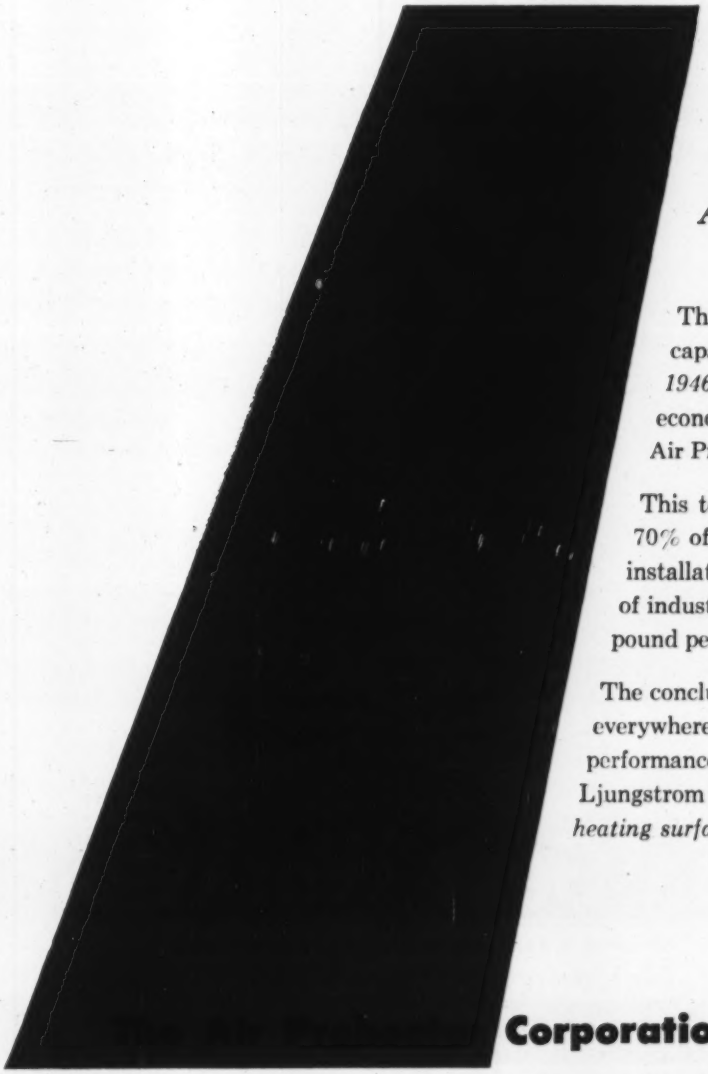

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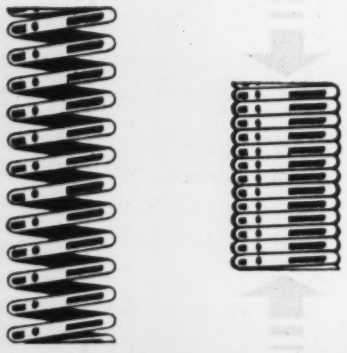

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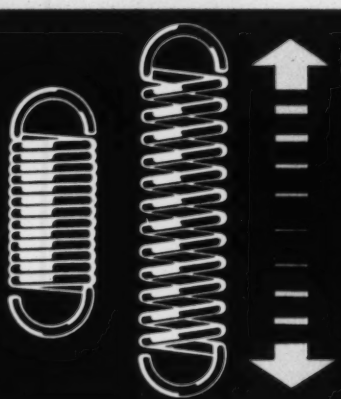

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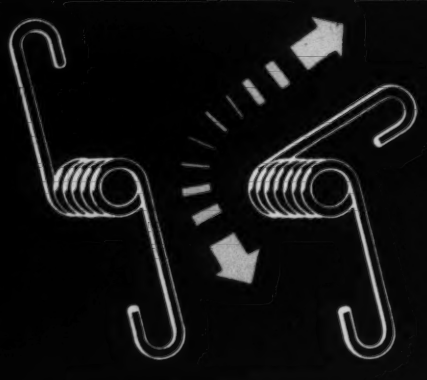

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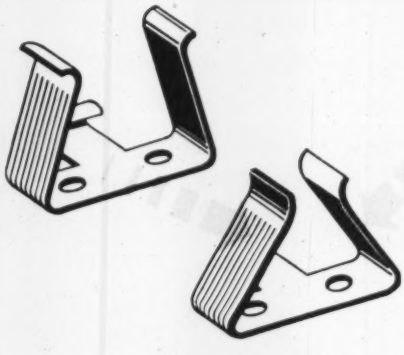

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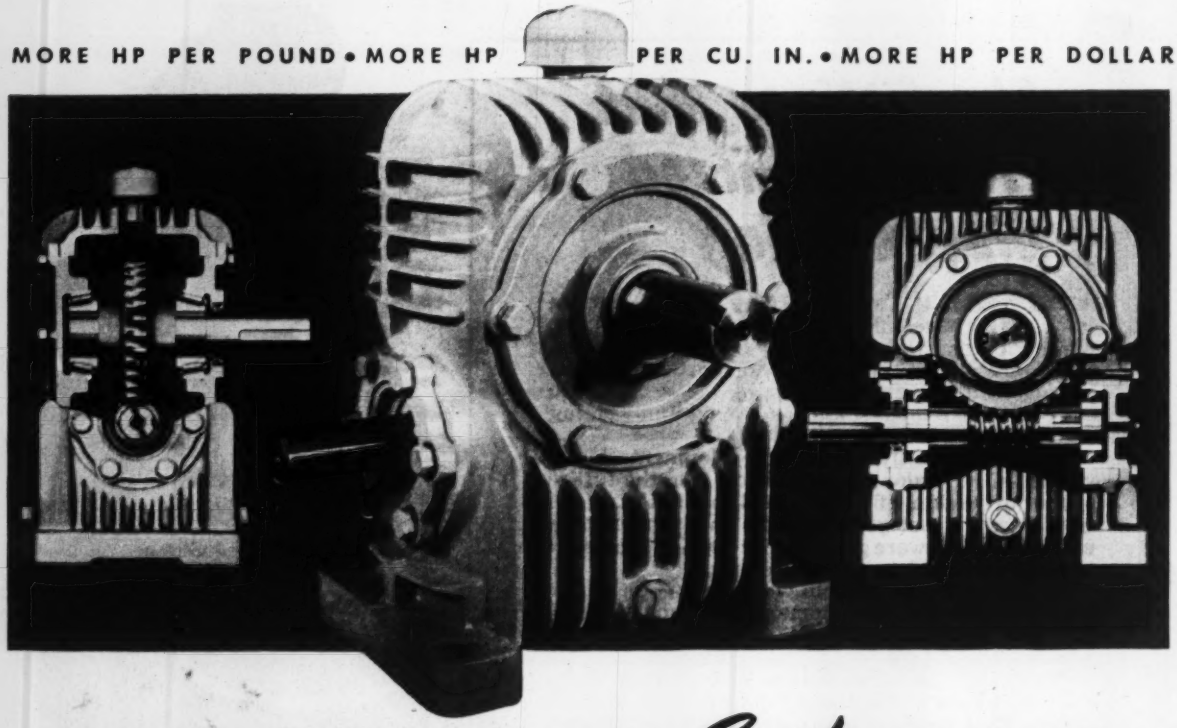

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Cone-Drive gears offers this versatility because of their modern manufacturing methods. All parts for a given center distance—gears, mountings, bearings, housings, fan-cooling attachments and water cooling coils, etc.—are standardized whether you require worm under or over, gear shaft vertical or horizontal, single or double-extended shafts, right or left hand. All of these parts are completely interchangeable for a given center distance, too.

Find out more about Cone-Drive speed reducers. Ask for Bulletin 8901-50.

CONE-DRIVE GEARS

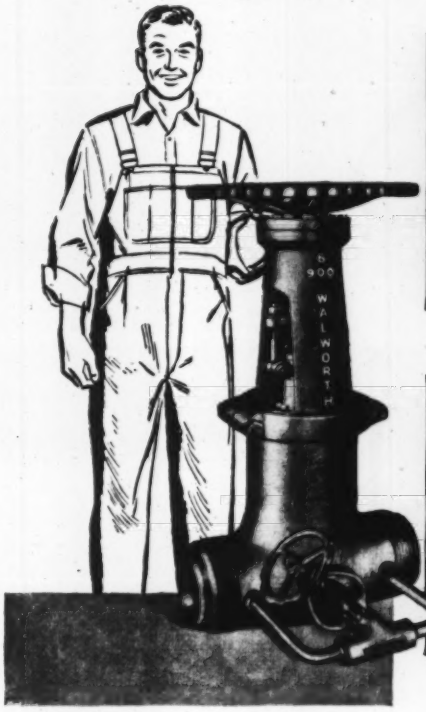
Division, Michigan Tool Company

DOUBLE ENVELOPING GEAR SETS & SPEED REDUCERS

7171 E. McNichols Road • Detroit 12, Michigan

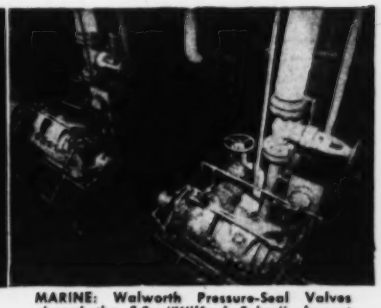
WALWORTH Pressure-Seal VALVES

For high-pressure, high-temperature services

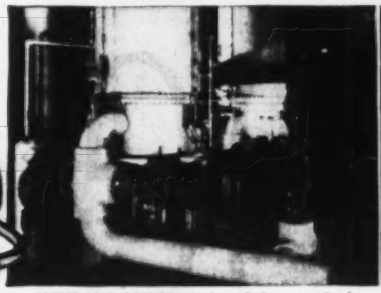


Walworth 6-inch Series 900 Pressure-Seal Gate Valve with Series 1500 Y-type Globe Valve on the by-pass.

CHEMICAL PLANT: Walworth Pressure-Seal Valves in the pressure reducing station of a chemical plant.



MARINE: Walworth Pressure-Seal Valves aboard the S.S. "Wilfred Sykes"—largest Great Lakes ore carrier.



LIGHT AND POWER: Walworth Pressure-Seal Valves equipped with motor operators, in an eastern public utility plant.

PAPER MILL: Fabricated header with 8-inch Series 600 Pressure-Seal Y-Globe Non-Return Valves and Series 600 Pressure-Seal Gate Valve.

SMALL VALVES FOR HIGH PRESSURE-TEMPERATURE SERVICE

Series 1500 Cast Steel Y-type Globe and Angle Valves in sizes ¼ to 2 inches.

The bonnet and body design of Walworth Pressure-Seal Valves is such that the pressure within the valve is used to prevent leakage at the junction of the bonnet and body. The bonnet joint of the Walworth Pressure-Seal Valve is permanently tight because there is no dependency on the ability of any component part of the joint to resist creep during long exposure to high temperature. Sudden temperature and pressure changes do not affect this tightness. Bonnet flanges and studs are eliminated and the weight of the valve is reduced.

An improved flexible disc design maintains seat tightness, even when the valve body is distorted by pipeline stresses or by temperature and pressure changes. This improved disc design makes it easier to open and close this valve.

Walworth Pressure-Seal Valves are easy to disassemble and assemble, and are the most satisfactory valves for high-pressure, high-temperature service. They are available in Series 600, 900, 1500, 2500 and in a wide range of sizes and types. For further information, write for Circular 116.

WALWORTH

valves • fittings • pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

Let's face it!

HAVE YOU A DISASTER PLAN FOR YOUR PLANT?

BOMBS... OR FIRE... OR FLOOD... OR TORNADO ... you can handle them if you act now.

Let's face it... the threat of war and the atomic bomb has become a real part of our life—and will be with us for years. Fires, tornadoes and other disasters, too, can strike without warning.

Whatever the emergency is, everybody's going to want help at the same time. It may be hours before outside help reaches you. The best chance of survival for you and your workers—and the fastest way to get back into production—is to know what to do and be ready to do it. Disaster may happen TOMORROW. Take these simple precautions TODAY:

☐ **Call your local** Civil Defense Director. He'll help you set up a plan for your offices and plant—a plan that's safer, because it's integrated with community Civil Defense action.

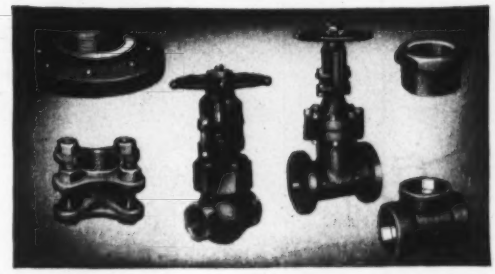
☐ **Check contents** and locations of first-aid kits. Be sure they're adequate and up to date. Here, again, your CD Director can help. He'll advise you on supplies needed for injuries due to blast, radiation, etc.

☐ **Encourage personnel** to attend Red Cross First-Aid Training Courses. They may save your life.

☐ **Encourage your staff** and your community to have their homes prepared. Run ads in your plant paper, in local newspapers, over TV and radio, on bulletin boards. Your CD Director can show you ads and official CD films or literature that you can sponsor locally. Set the standard of preparedness in your plant city. There's no better way of building prestige and good community relations—and no greater way of helping America.

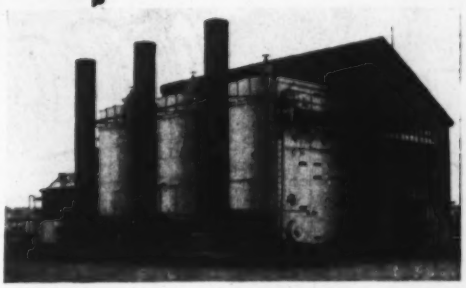
Act now . . . check off these four simple points . . . before it's too late.

Designed for today's *Tough* service demands



DROP FORGED VALVES AND FITTINGS FOR TOUGHNESS AND TROUBLE-FREE SERVICE

Drop forged from carbon and alloy steels, Vogt valves, fittings and flanges will safely handle liquids and gases at high pressures and high temperatures in power plants, chemical plants, petroleum refineries, etc. The complete line includes flanged, screwed and socket weld end globe, gate and check valves—ells, tees, and crosses—couplings—bushings—plugs—unions—flanges and flange unions—and welding heads.

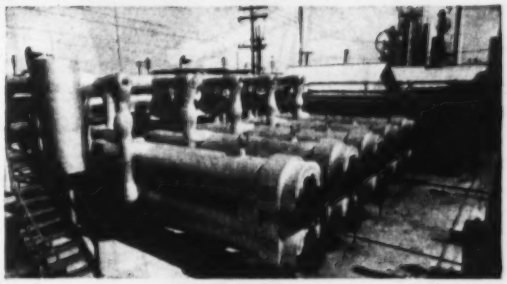


MODERN STEAM GENERATORS

Vogt steam generators are designed to give maximum rating in a minimum of space, with high efficiency and low maintenance expense. Bent tube types and straight tube, forged steel sectional header types to burn solid, liquid or gaseous fuels meet every power, process or heating requirement.

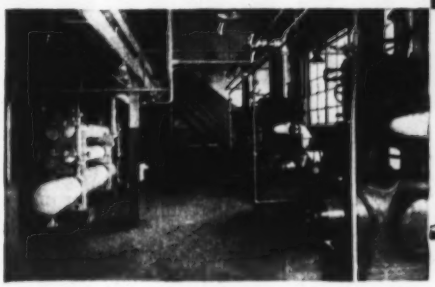
PROCESS EQUIPMENT FOR EVERY SERVICE

Vogt constructs process equipment in wide variety to all Codes. Stills and towers, oil chillers, crystallizers, heat exchangers, molding machines, etc., serve in the manufacture of oils, greases, 100 octane gasoline, synthetic rubber, chemicals and related products around the world.



SPECIAL MATERIALS COMBAT CORROSION AND PRODUCT CONTAMINATION

Our modern shops produce a wide variety of equipment from special metals and alloys to fight corrosion and product discoloration or contamination. Fabrication procedures insure that corrosion resistant properties of welds will match that of the materials used to construct the equipment.



Vogt

PRODUCTS

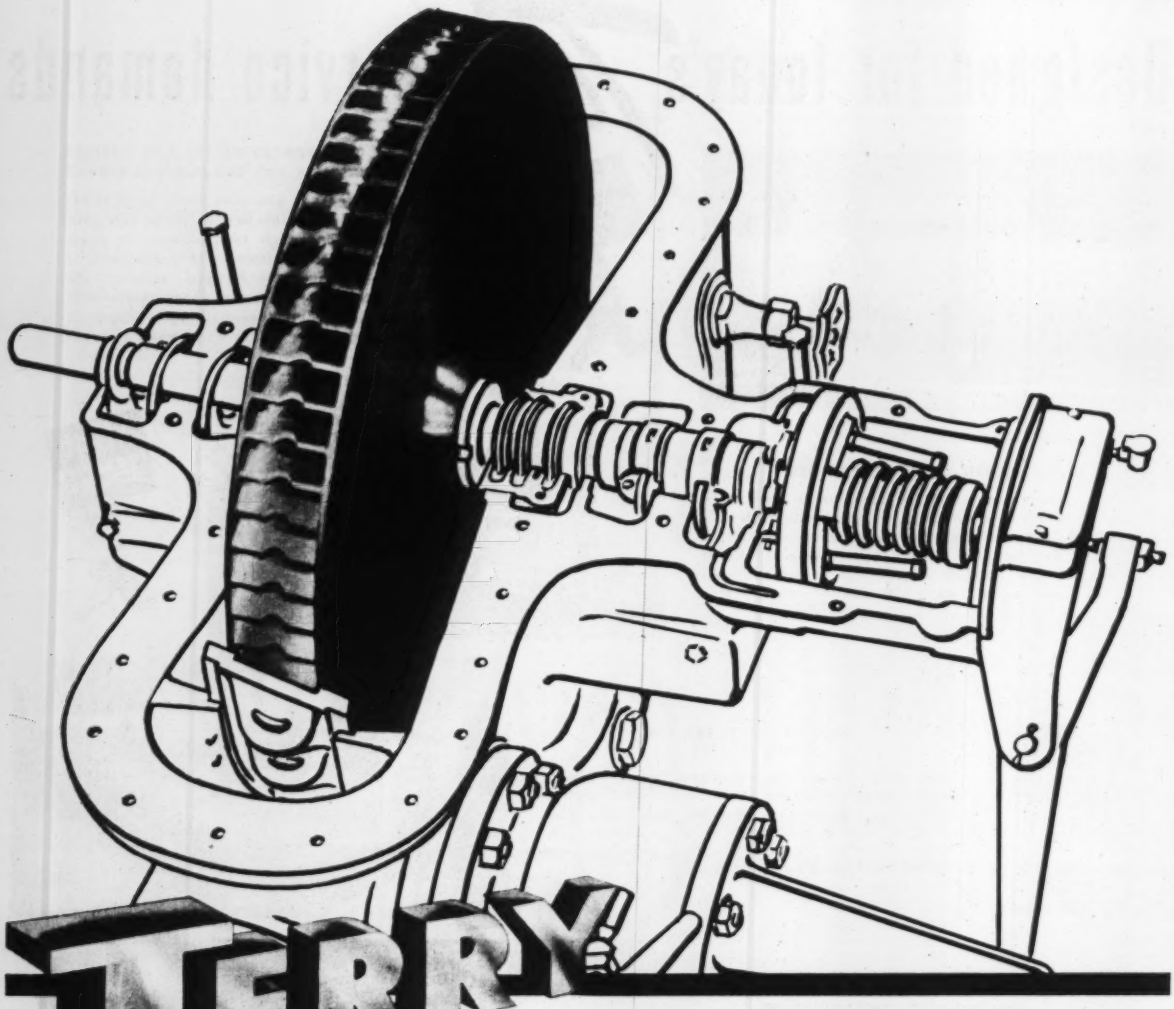
FOR REFINERIES, CHEMICAL PLANTS POWER PLANTS AND PROCESS INDUSTRIES

HENRY VOGT MACHINE CO.
LOUISVILLE 10, KY.

BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland St. Louis, Dallas, Charleston, W. Va.

MORE REFRIGERATION TONNAGE AT LESS COST

More than 70 years of engineering and manufacturing experience is incorporated in Vogt refrigerating and ice making equipment. Absorption Systems, Compression Systems, and Tube-Ice Machines in a wide range of capacities serve industrial and processing plants, and institutions, here and abroad.



SOLID WHEEL RUGGEDNESS

is your turbine dividend

The rugged construction and fool-proof design of a Terry solid-wheel turbine can save you money by keeping maintenance costs to a minimum. Usually only taken down for routine inspection, any repairs that must be made are of relatively simple nature, and cost of replacement parts is small.

The rotor of the turbine is a single forging of special composition steel, in which a series of semi-circular buckets is milled. There are no separate parts to loosen or work out. As the only function of the blades is to form a series of pockets, any wear which might occur would not materially affect horsepower or efficiency.

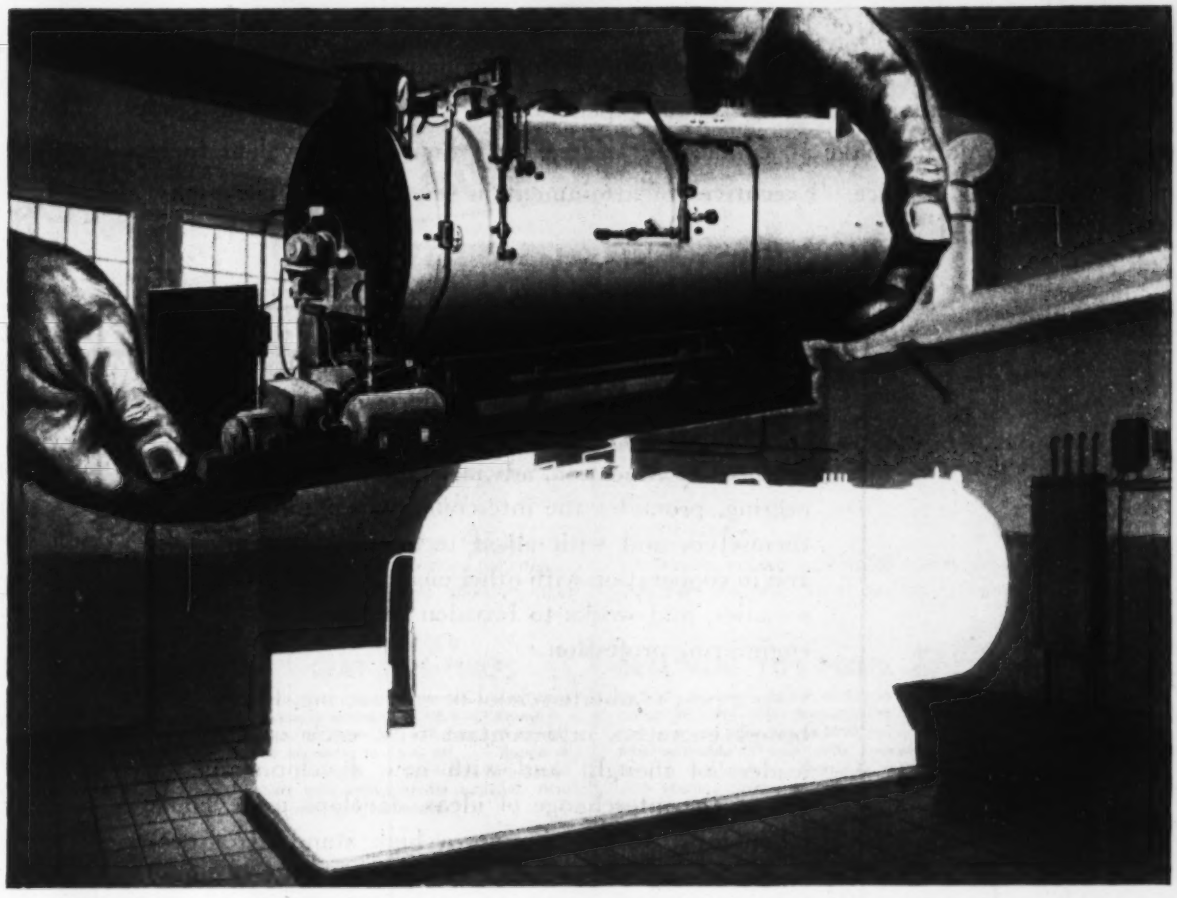
It is impossible for the blades to foul. They have large clearances and are further protected by the projecting rims of the sides of the wheel. As the side clearances are also very large, end play can do no harm.

The Terry solid-wheel turbine is an extremely reliable piece of equipment—why not write for complete details today? Ask for a copy of Bulletin S-116.

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD 1, CONN.

TT-1198

Here's why you get more...when you buy a Cleaver-Brooks Self-Contained Boiler



...only Cleaver-Brooks can offer you the experience gained from more than 20 years of pioneering . . . and more than 12,000 individual "packaged" boiler installations

CLEAVER-BROOKS pioneering has been largely responsible for simplifying boiler buying . . . lowering costs of installation . . . delivering 80% guaranteed steam efficiency from every fuel dollar.

Boilers can be shipped as completely assembled and tested self-contained units, with auxiliaries as required. Installation involves minimum of time, construction and space. Usually connections only to steam, fuel, water lines and electrical service are needed. No special foundations are required. A short vent takes care of exhaust gases. Frequently, boilers are ready for use in a matter of *hours*, depending on availability of service lines.

Cleaver-Brooks, originators of the self-contained boiler, offers wider experience that counts in another important way. Qualified engineers help you plan steam plants tailored *exactly* for your needs. Carefully analyzed are loads, space and equipment arrangement. This not only helps you solve present steam needs, but adds flexibility for future expansion as well.

This application engineering, plus basically sound design and construction is your assurance of a full return from your boiler investment. When you specify a self-contained boiler — make sure it's a Cleaver-Brooks.

Cleaver-Brooks steam or hot water boilers for heating and processing are available for oil, gas or combination oil/gas firing. Sizes: 15 to 500 hp. 15 to 250 psi. Write for Catalog AD-100.

CLEAVER-BROOKS COMPANY
Dept. B, 318 E. Keefe Ave.
Milwaukee 12, Wisconsin, U.S.A.

Cleaver-Brooks

ORIGINATORS OF THE SELF-CONTAINED BOILER

Steam Boilers • Oil and Bitumin Tank Car Heaters • Distillation Equipment Oil and Gas Fired Conversion Burners

TO THE MEMBERS OF———

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

Members of the ASME are invited to name any number of engineers as candidates for membership. Engineering acquaintances should be qualified by both fundamental training and experience for one of the technical grades. Those who do not have an engineering degree may show the equivalent thereof through actual practice. Executives of attainment in science or industry may affiliate as Associates.

THE American Society of Mechanical Engineers promotes Mechanical Engineering and the allied arts and sciences, encourages original research, fosters engineering education, advances the standards of engineering, promotes the intercourse of engineers among themselves and with allied technologists; separately and in cooperation with other engineering and technical societies, and works to broaden the usefulness of the engineering profession.

As a post graduate school of engineering, the Society brings engineers into contact with each other, with leaders of thought and with new developments; it fosters the interchange of ideas, develops professional fellowships, and encourages a high standard of professional conduct—all with the purpose of advancing civilization and increasing the well-being of mankind.

C. E. Davies, Secretary
The American Society of Mechanical Engineers
29 West 39th Street, New York 18, N. Y.

Date.....

Please send an application and information regarding ASME to the following:

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Address.....
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ME-2-54

PUMPS for INDUSTRY

FLUID POWER PUMPS

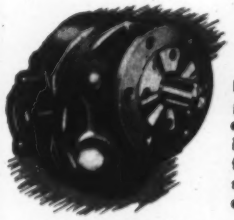
The most comprehensive range of types, capacities and pressures in Hydraulic Pumps for industrial equipment, presses, machine tools, materials handling, metal working, mobile equipment, mining, petroleum, gas and aviation applications. Hydraulic Pumps, Motors, Cylinders and Valves to develop complete Hydraulic circuits.

LIQUID HANDLING PUMPS

An exceptionally broad range of types, sizes and special constructions to handle virtually "any substance that will flow through a pipe" including: water, petroleum products, alcohols, syrups, acids, sludges, slurries, asphalt, bunker fuel, etc.

VACUUM PUMPS

High Vacuum Pumps for laboratory, electronic, atomic research, biological and other chemical processing, vacuum refining of metals, de-aerating, dehydration, vacuum drying, refrigeration.

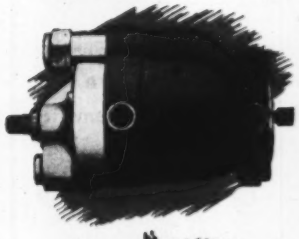


HYDRECO
GEAR TYPE PUMPS

Reversible and non-reversible. Gear type pumps in exclusive FOUR-BOLT design . . . capacities from .5 to 130 gpm and operating pressures to 1500 psi . . . flange or foot mounted . . . furnished with keyed shaft with spline shafts optional. Also dual and tandem models.

DUDCO
DUAL VANE TYPE PUMPS

DUDCO Pumps provide a broad range of sizes with capacities to 120 gpm and pressures to 2000 psi. Also available in dual units operating from a single drive. Hydraulic motors with starting torque outputs to 14,400 lb. in.

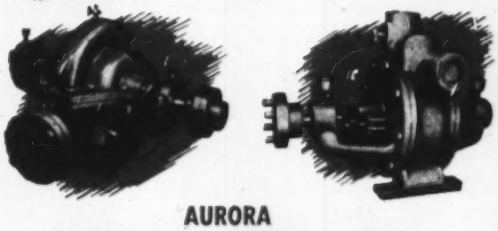


STRATOPOWER
PISTON TYPE PUMPS

Axial reciprocating piston type . . . constant or variable delivery with capacities of .25 to 10 gpm at nominal speeds of 1500 rpm with maximum of 4500 rpm . . . working pressures to 3000 psi . . . direct engine and individual electric motor driven models.

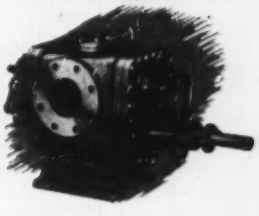
KINNEY
VACUUM PUMPS

Single stage models to produce absolute pressure readings of 10 microns (.01 mm Hg.) . . . compound pumps producing readings of .2 microns (.0002 mm Hg.) or better. These Kinney High Vacuum Pumps are available in sizes for laboratory as well as high production use.



AURORA
CENTRIFUGAL & TURBINE PUMPS

Deep well, sump, drainage and condensation return units, household water systems. Industrial low and high pressure liquid handling pumps. Direct motor and countershaft driven horizontal and vertical models. Capacities 3 to 7500 gpm.



KINNEY
LIQUID HANDLING PUMPS

A complete range of sizes in Rotating Plunger and Herringbone Gear Pumps to handle light or heavy liquids from gasoline to molasses. Available in plain or steam jacketed models.

THE NEW YORK AIR BRAKE COMPANY
230 PARK AVENUE • NEW YORK 17, N. Y.

THE NEW YORK AIR BRAKE COMPANY
230 Park Ave., Dept. ME-1, New York 17, N. Y.

Gentlemen: Kindly send me additional information on: Hydraulic Pumps ☐ 1000 psi ☐ 2000 psi ☐ 3000 psi Liquid Handling Pumps ☐ Vacuum Pumps ☐

Name.....

Address.....

City..... **State**.....

"Let's be sure they're listed for all 3"

"Check your records, Miss Webster, to be certain we have Wolverine listed as a supplier of copper, aluminum, and electric-welded steel tubing.

"That gives us a single source for the three kinds of tubing we use here. Oh, yes, make a note that Wolverine can supply us with technical help. They tell me up in engineering that Wolverine has smoothed out some rough spots for them on the last job."

It's in the cards: Make sure that Wolverine is in your files as a one-source supplier of copper, aluminum or electric-welded steel tubing. And make sure that you address your company's technical problems to Wolverine's Field Engineering Service.

If you want capsulized, helpful information—send for Wolverine's handy Statement of Scope. It tells at a glance what Wolverine can do for you.

And make sure you give this memo to your secretary today—WOLVERINE TUBE DIVISION, of Calumet & Hecla, Inc., 1483 Central Ave., Detroit 9, Michigan.

MEMO: *"Make sure that Wolverine is listed for all 3—tubing of copper, copper base alloys, aluminum and electric-welded steel."*

WOLVERINE TUBE DIVISION
OF CALUMET & HECLA, INC.
EST. 1916
Manufacturers of Quality Controlled Tubing

PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. • Sales Offices in Principal Cities
EXPORT DEPT., 13 E. 40th ST., NEW YORK 16, N. Y.

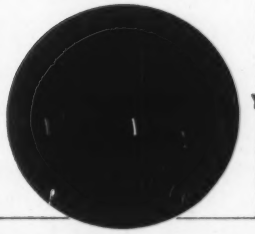
Here's

the

BIG TRUTH*

about

boilers...



***The only safe way to select boilers is on nominal capacity to operate at "cruising speed"...**

KEWANEE

reserve + rating = plus

guarantees dependability, higher efficiency, lower costs, longer life—because it means "cruising speed" operation.

There's a lot of confusion in sizing boilers today because rating methods have not been brought into the open with a clear-cut definition. That's all changed with Kewanee Reserve Plus Rating. Here for the first time these truths are stated: Only nominal-rated boilers with built-in reserve *safely provide* efficiency—low maintenance—dependability—longer life. Only nominal-rated boilers *safely provide* for fluctuating loads—emergencies—expansion.

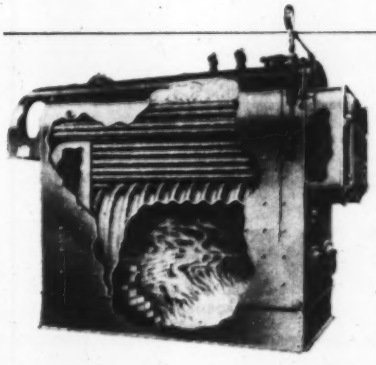
So when you consider "bidding data" be sure you compare like examples . . . know whether ratings are based on maximum capacity or nominal capacity.

Follow the Kewanee Reserve Plus Rating Plan which is based on the commercial code of the Steel Boiler Institute. Kewanee Reserve Plus certifies 50% or more extra power for pick-up and additional capacity. Kewanee gives you complete data and dimensions, so you can realistically consider sizing requirements.

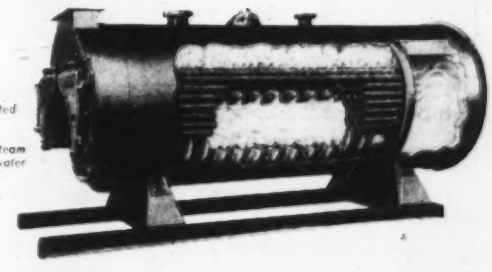
You can count on KEWANEE engineering

KEWANEE-ROSS CORPORATION • KEWANEE, ILLINOIS
Division of American Radiator & Standard Sanitary Corporation

Serving home and industry • American-Standard • American Blower Church Seats & Wall Tile • Detroit Controls • Kewanee Boilers Ross Exchangers • Sunbeam Air Conditioners



Kewanee type "C" boiler
with exclusive corrugated crown sheet. 16 sizes for oil, gas or stoker 3650—42500 sq. ft. steam 5840—68000 sq. ft. water



M-800 series boiler
Here is rugged "M-800" Series Scotch Boiler constructed in 13 sizes for high pressure steam 39 to 304 horse power and low pressure 15 lb. steam or 30 lb. water.

This Lectrodryer assures a DRY protective atmosphere. It works continuously, automatically and economically, DRYing atmosphere at the Gary Sheet and Tin Mill, of the United States Steel Company.

When your PROTECTIVE ATMOSPHERE must be DRY...

You can avoid metal discoloration and decarburization caused by moisture in your protective atmosphere. A Lectrodryer* installed between the atmosphere source and the heat-treating oven or furnace will extract moisture from the atmosphere, DRYing it to dewpoints as low as −110°F.

Your gas-generator manufacturer is an expert on this subject. He can quickly discover the source of your moisture trouble and advise you best. Chances are, he'll recommend a Lectrodryer if your protective atmosphere must be DRY. Write Pittsburgh Lectrodryer Corporation, 335 32nd Street, Pittsburgh 30, Pennsylvania.

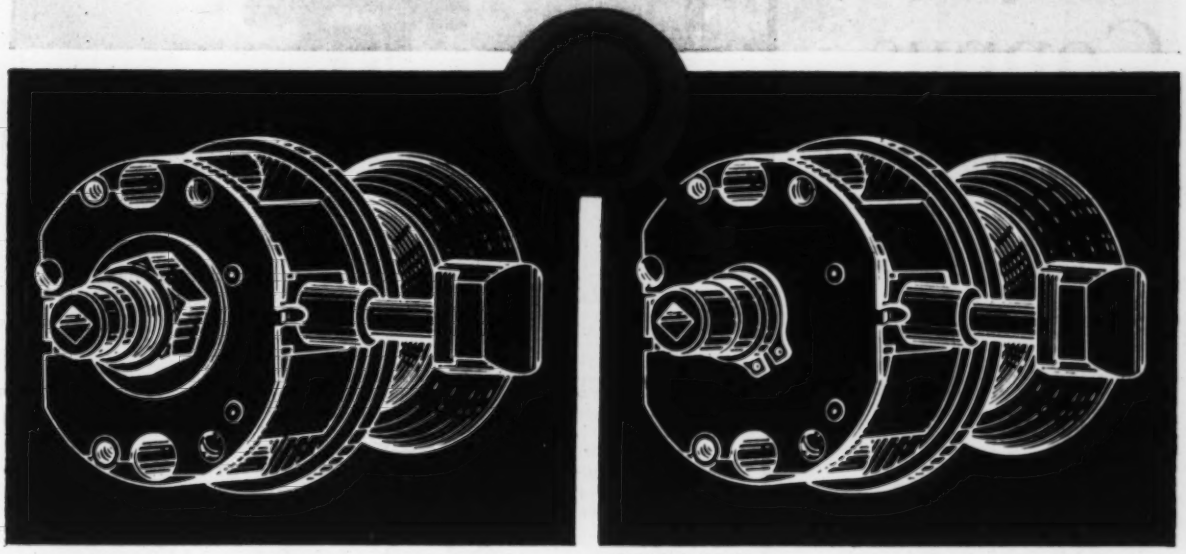
In England: Birlec, Limited, Tyburn Road, Erdington, Birmingham.
In France: Stein et Roubaix, 24 Rue Erlanger, Paris XVI.
In Belgium: S. A. Belge Stein et Roubaix, 320 Rue du Moulin, Bressoux-Liege

LECTRODRYERS DRY WITH ACTIVATED ALUMINAS

LECTRODRYER

* REGISTERED TRADEMARK U.S. PAT. OFF.

Waldes Truarc Ring Replaces Nut and Washer ...Cuts Costs $5.28 Per M...Speeds Assembly by 50%



OLD WAY. Main shaft required costly threading. Assembly was slowed by the double application of washer and nut and time-consuming tightening operation.

TRUARC WAY. Truarc Retaining Ring snaps quickly and simply over shaft. Lock assembly is secured in one fast operation. Virtually all play is eliminated from lock.

NEW DESIGN USING WALDES TRUARC RING PERMITTED THESE SAVINGS

OLD WAY

Cost of Nut	$10.00	*per thousand*
Cost of Washer	3.80	" "
Labor for Threading . . .	2.00	" "
Assembly	3.00	" "
TOTAL	$18.80	

TRUARC WAY

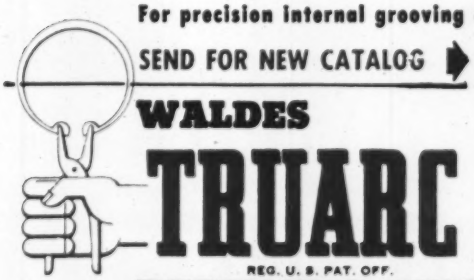
Cost of Truarc Ring and Grooving Operation . .	$11.52	*per thousand*
Assembly	2.00	" "
TOTAL	$13.52	

J. Chesler and Sons, Inc., Brooklyn, N.Y., manufacturers of the pre-assembled "Reddi-Mount" cylindrical lockset, uses a single Waldes Truarc Retaining Ring instead of an old fashioned nut and washer to secure the entire assembly of their lock. This new, improved fastening method enables Chesler to eliminate costly threading . . . save money on material . . . speed assembly time by 50% and produce an improved, more durable product.

You, too, can save money with Truarc Rings. Wherever you use machined shoulders, bolts, snap rings, cotter pins, there's a Waldes Truarc Retaining Ring designed to do a better, more economical job. Waldes Truarc Rings are precision-engineered . . . quick and easy to assemble and disassemble.

Find out what Waldes Truarc Retaining Rings can do for you. Send your blueprints to Waldes Truarc engineers.

For precision internal grooving and undercutting...Waldes Truarc Grooving Tool



SEND FOR NEW CATALOG

WALDES

TRUARC

REG. U. S. PAT. OFF.

RETAINING RINGS

WALDES KOHINOOR, INC., LONG ISLAND CITY 1, NEW YORK

WALDES TRUARC RETAINING RINGS AND PLIERS ARE PROTECTED BY ONE OR MORE OF THE FOLLOWING U. S. PATENTS: 2,382,947; 2,382,948; 2,416,852; 2,428,341; 2,439,785; 2,441,848; 2,455,165; 2,470,941; 2,483,380; 2,483,383; 2,487,802; 2,487,803; 2,491,306; 2,509,081 AND OTHER PATENTS PENDING.

ME096

Waldes Kohinoor, Inc., 47-16 Austel Pl., L. I. C. 1, N. Y.

Please send me the new Waldes Truarc Retaining Ring catalog.

(Please print)

Name.....

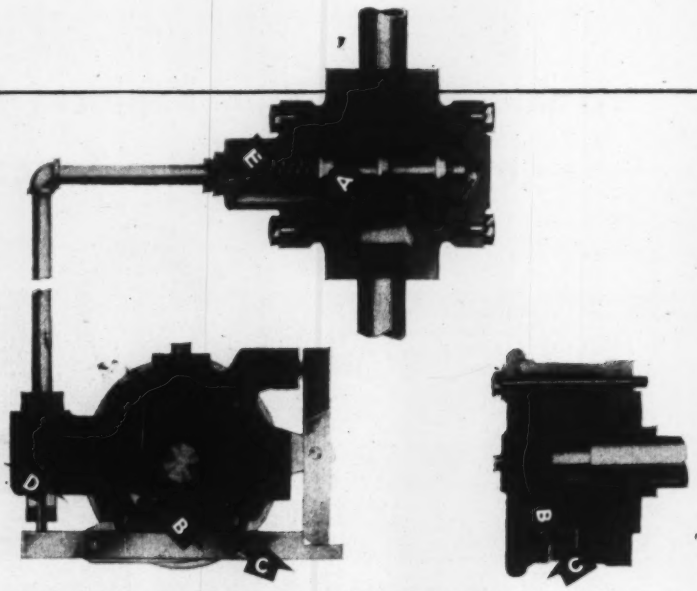
Title .....

Company .....

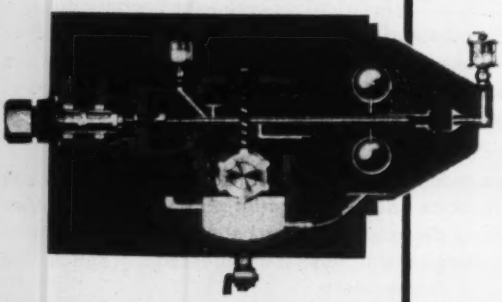
Business Address.....

City..... *Zone*..... *State*.....

Only Coppus Turbines offer you *a pilot operated* excess speed safety trip



The constant speed governor on Coppus Turbines, plus this Excess Safety Trip, gives you extra protection for your turbine investments. Here's how it works. When turbine is operating, Lever C is horizontal, Pilot Valve D closed, and Valve A held open by Spring E. When excess speed is reached, centrifugal force throws Weight B against Lever C, opening Pilot Valve D. This relieves the pressure back of Valve A, unbalancing and closing it immediately, compressing Spring E and shutting off the steam supply to the turbine. When Lever C is manually reset, Pilot Valve D closes, allowing pressure to build up back of Valve A and thus restoring the balance. Spring E then opens Valve A, admitting steam to turbine.



Sectional view showing lubricating system of fully enclosed Coppus Constant Speed Governor. Governor head acts directly on stem of steam admission valve. No external levers required. Ball bearing construction eliminates end play and gives frictionless operation.

Coppus Turbines ranging from 150 hp down to fractional in 6 frame sizes

CUT YOUR COSTS PER HORSEPOWER

When you choose from the Coppus Steam Turbine line, you get the right size for your requirements . . . and make substantial savings on *any* size from the 150 hp turbine down to the smallest. Low in first cost, Coppus Turbines save you more money in the long run. Operating and maintenance costs are kept low by such other features as: large number of steam nozzles, controlled individually by manually operated valves; hard chromium plating on shaft at the stuffing box; replaceable cartridge type bearing housings; optional carbon ring packing assembly for back pressures up to 75 pounds.

WRITE FOR BULLETIN 135

COPPUS ENGINEERING CORPORATION 362 Park Ave., Worcester 2, Mass. Sales offices in THOMAS' REGISTER.

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The most convincing stamp of user satisfaction →

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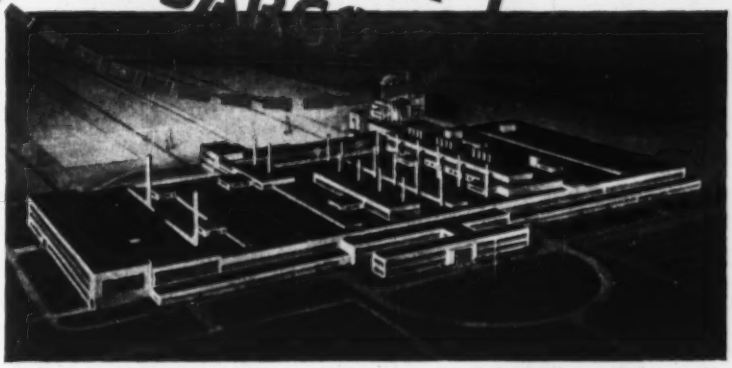

Ford Foundry, Cleveland. *Architects and Engineers:* F. A. Fairbrother and George H. Miehls. *Consultants.* Albert Kahn Associated Architects and Engineers, Inc., Detroit. *Heating Contractors:* Smith and Oby Co., Cleveland.

8 Ford Plants now rely on Sarco dependability

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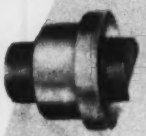

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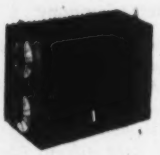
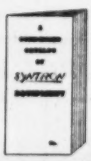


Throughout a wide range of industrial installations, Syntron Equipment continues to reduce production costs. Its extremely low maintenance and rugged dependability make it the natural choice for many automatic processing installations.

This complete miniature catalogue, illustrating and briefly describing Syntron Equipment will be sent Free - upon request.



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• *For research in and development of electromechanical radar and computing equipment.*

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The work calls for devising reliable, maintainable, manufacturable designs for precision equipment developed in the Hughes Radar Laboratory. Equipment consists of mechanical, electronic and microwave devices and systems to be manufactured in quantity. Designs require use of such advanced techniques as subminiaturization and unitized "plug-in" construction. Knowledge of electronic components, materials, finishes and specifications is useful.

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Engineers experienced in the field of electromechanical design for production or those interested in entering this field will find outlets for their abilities and imagination in these activity areas. New electromechanical techniques are opening new applications for airborne electronic equipment. Hughes engineers will have the full benefit of working experience in these fundamental developments.

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MECHANICAL ENGINEERING

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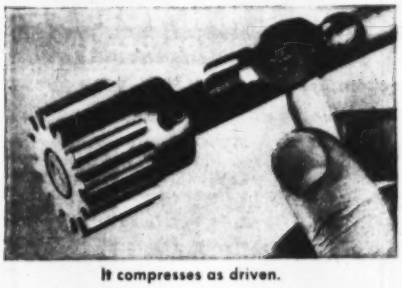
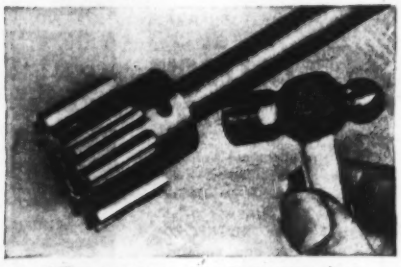


It compresses as driven.



Rollpin fits flush . . . is vibration-proof.

Rollpin is the slotted tubular steel pin with chamfered ends that is cutting production and maintenance costs in every class of industry.

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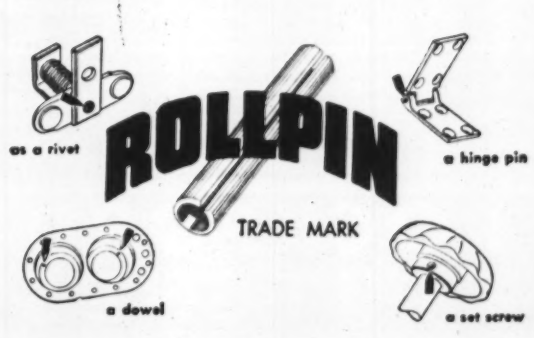
If you use locating dowels, hinge pins, rivets, set screws—or straight, knurled, tapered or cotter type pins—Rollpin can cut your costs. Mail our coupon for design information.



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To increase the efficiency of your compressor, send us the name, bore, stroke and speed of your machine. Our detailed proposal will be sent without obligation.

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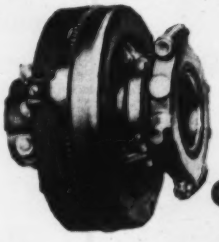

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ROCKFORD clutch engineers are helping product designers reduce costs — by making possible *quicker clutch assemblies, easier clutch adjustments,* and *after-sale clutch service unnecessary.* Because ROCKFORD CLUTCH precision, capacity and stamina are greater than ever, product owners' upkeep costs are lower. Now is the time to have ROCKFORD clutch engineers give *your product* the benefits of lower clutch costs plus competitive operating advantages.

Send for This Handy Bulletin

Gives dimensions, capacity tables and complete specifications. Suggests typical applications.

ROCKFORD CLUTCH DIVISION
BORG-WARNER
1307 Eighteenth Avenue, Rockford, Illinois

ROCKFORD CLUTCHES

Keeping Thermal Expansion Under Control

Flexible support for piping in all positions of travel must be provided, if destructive stresses and strains are to be avoided in today's high temperature piping systems.

Heat 100 linear feet of alloy steel pipe to 1000° F, and it will expand 9.1 inches! When this thermal expansion takes place in a piping system, the resultant forces induced, if uncontrolled, can do incalculable harm.

Helical coil springs

The practice of using helical coil springs to allow this thermal expansion to occur is quite general. But the care that goes into the design or selection of flexible supports ofttimes is haphazard. In fact, many specifications covering the support of important high temperature piping will simply say "spring hangers shall be provided". Merely to contend that this may be dangerous is not enough.

Safety of entire system at stake

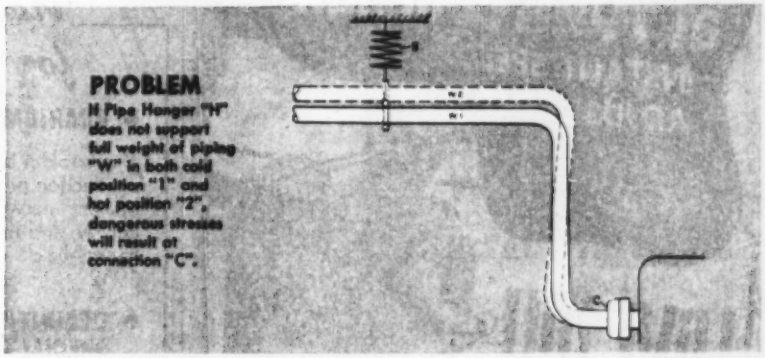
Unless careful study is given to the design and selection of spring supports which will maintain a balanced pipe system, the transfer of weight from one hanger to another, or from a hanger to a terminal point, will endanger the safety factor of the entire system.

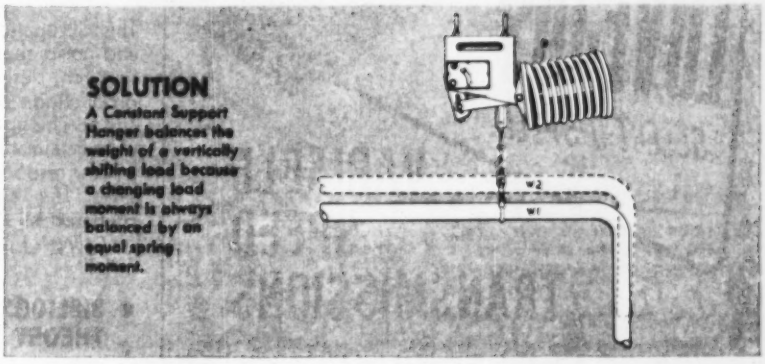
With 8 . . . 9 . . . even 10 inches of thermal deflection not a bit uncommon today, completely flexible support for piping in all positions of travel is a positive "must".

The case for constant-support hangers

Where reactive forces at terminal points in a piping system must be kept within specified limits, constant support type hangers are recommended.

They are designed to provide uniform supporting force equal to the pipe load throughout the travel range and should be used at superheater outlets, turbine connections, and also on high temperature and other critical lines.

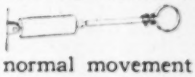

PROBLEM
If Pipe Hanger "H" does not support full weight of piping "W" in both cold position "1" and hot position "2", dangerous stresses will result at connection "C".


SOLUTION
A Constant Support Hanger balances the weight of a vertically shifting load because a changing load moment is always balanced by an equal spring moment.

Variable spring hangers

When pipe lines are subject to vertical movement, and restrictive conditions do not require a constant-support type hanger, variable spring hangers are recommended. They should be designed to support not less than 85%, or more than 120%, of the design load throughout the total travel.

Vibration control and sway brace



When necessary to prevent abnormal movement or vibration in pipe lines, controls or sway braces of the energy-absorbing or instant-acting counter force type, are recommended. They dampen vibration, oppose pipe sway and absorb shock.

Hanger Engineering Service

The Pipe Suspension Department of Grinnell Company offers a design service to engineering firms which appreciate the specialized knowledge required to compute hanger loads and to select the proper supports for a balanced pipe suspension system when high pressures and high temperatures are involved.

Grinnell manufactures a complete line of pipe hangers and supports; maintains an experienced laboratory staff of technicians to discover better ways of solving pipe suspension problems; provides engineering assistance in design and installation; offers stocks of pipe hangers close to any job.

Hanger load calculation booklet

A 28-page booklet entitled "Hanger Load Calculations", compiled to furnish necessary data and procedure to determine pipe hanger loads, can be obtained from Grinnell Company. The tabulations of piping weights and thermal expansion have been arranged for convenient selection of data that otherwise consume considerable time to develop. It's yours without obligation.

GRINNELL COMPANY, INC.

254 West Exchange St., Providence, Rhode Island

Kindly send me a complimentary copy of your "Hanger Load Calculations" booklet.

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Company.....

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This occupational information book contains current and comprehensive data related to activities such as research, design, development, testing, procurement, production, construction, operation, administration and teaching, and to twenty-three engineering fields of specialization, including the special knowledge, duties, responsibilities and related techniques necessary. The definitions—approximately 500—were prepared by the ASME with the assistance of representatives of pertinent engineering societies.
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In this Bibliography are 1845 chronologically arranged references to practically all important articles on the theory of plasticity, particularly of metals, and on its application to engineering problems. The references have been culled from books and periodicals published in the U. S. and other countries from 1835 to 1949. Subject and author indexes are included.
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Towmotor units operate the world over—loading ships—lifting steel coils and bars to trucks or stacking lumber, stone and finished products. Do you know of a greater test for gears?

Towmotor depends on Ohio Gears to insure their products' operation and reputation at home and abroad.

Towmotor is another good reason why more automotive designers are specifying Ohio Gears. Perhaps Ohio Gear can do as much for your product. See their nearest distributor or write direct.

Pictured here are Ohio Gear's power transmission units used in Towmotor's, 2-ton load, Diesel powered model 480-PD Fork Lift Truck.

ESTABLISHED 1915
THE OHIO GEAR COMPANY
1360 EAST 179th STREET • CLEVELAND 10, OHIO

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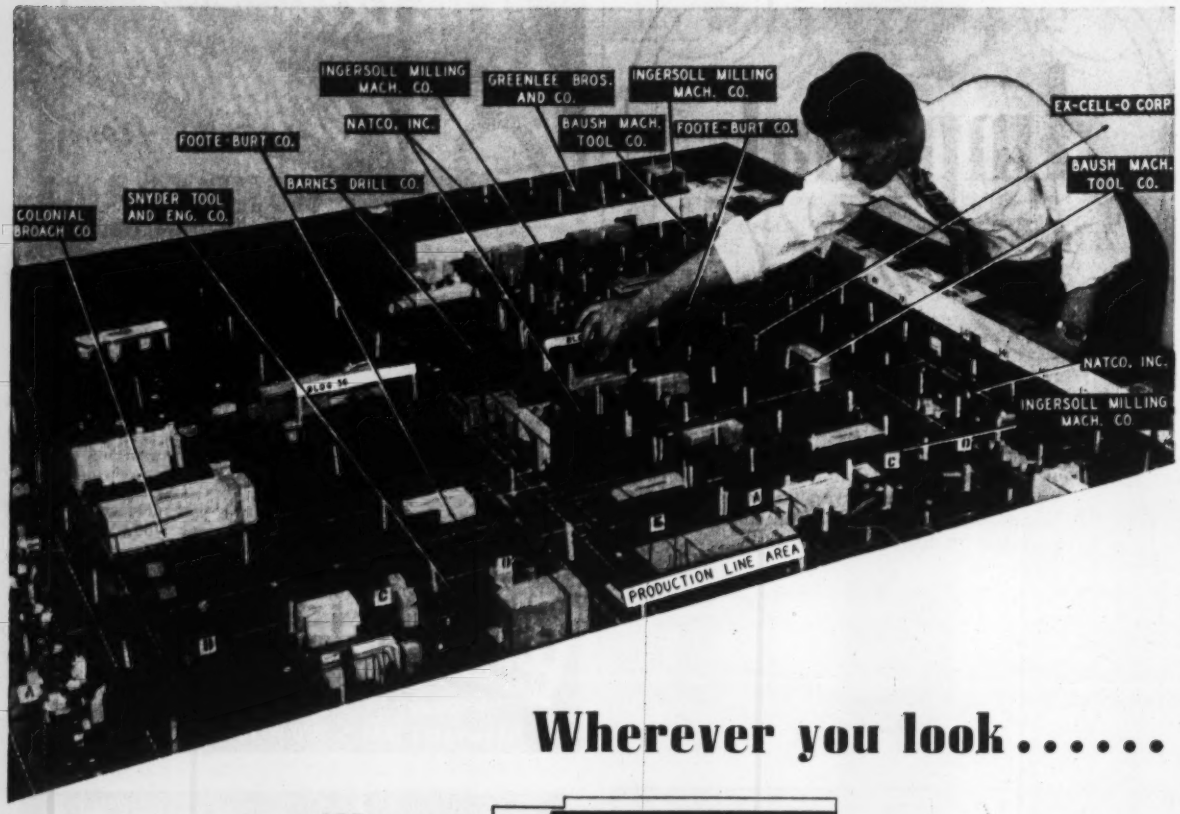

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RATES Classified Advertisements under this heading in MECHANICAL ENGINEERING are inserted at the rate of $1.70 a line. $1.35 a line to members of ASME. Seven words to the line average. A box number address counts as one line. Minimum insertion charge, 5 line basis. Display Advertisements carried in single column units of multiples of one inch at flat rate of $28 per inch per insertion. Copy must reach us not later than the 10th of the month preceding date of publication.

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—of long-established technical magazine in the field of general mechanical engineering. Must be graduate of engineering school with practical engineering experience; under 35 years of age, with ability to do original writing, rewriting, and abstracting, reporting and interviewing, and willing to travel. Location New York. Salary open. Permanent position. Apply by letter with photograph, record of school and engineering work, and references.

Address CA-4596, % "Mechanical Engineering."

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PLEASE GIVE COMPLETE DETAILS OF BACKGROUND, INCLUDING EDUCATION, EXPERIENCE, PERSONAL DATA AND SALARY DESIRED.

All replies will be promptly acknowledged.

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Long established manufacturer of specialized conveying and processing equipment has opportunity for man 25-35 years old to handle technical sales work and engineering supervision on the West Coast.

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This position requires 1 to 2 years of training and experience in our engineering and sales office in New York.

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MECHANICAL ENGINEERING—student University of New Hampshire 1955. Age 34, married, seeks summer employment June-September. Interested in production methods or related fields. 5 years' industrial experience. Address CA-4588, care of "Mechanical Engineering."

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ENGINEER—age 28, B.S. Yale, 3 yrs.' engineering experience in Europe, fluent French and Italian. Knowledge of industrial and manufacturing methods, with experience in shop and design work in USA. Building construction experience, including electrical and mechanical installations and maintenance. Recently employed as electrical engineer preparing complete designs, specifications, and estimates of lighting and power facilities for commercial and institutional buildings and distribution systems. Administrative ability. Desires eventual permanent location in Europe. Willing to undertake intensive training here or abroad; free to travel, interested in languages. Address CA-4594, care of "Mechanical Engineering."

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PATENTS FOR SALE—U.S. Patents No. 2,588,276; No. 2,595,599; and No. 2,647,646 applying to materials handling equipment for concrete masonry. Address CA-4590, care of "Mechanical Engineering."

Additional Opportunities are offered in the display advertisements—on pages 48, 51, 52, 56, 130

READ the CLASSIFIED ADVERTISEMENTS *appearing in this section each month.*

The LONGER LIFE of WROUGHT IRON PIPE

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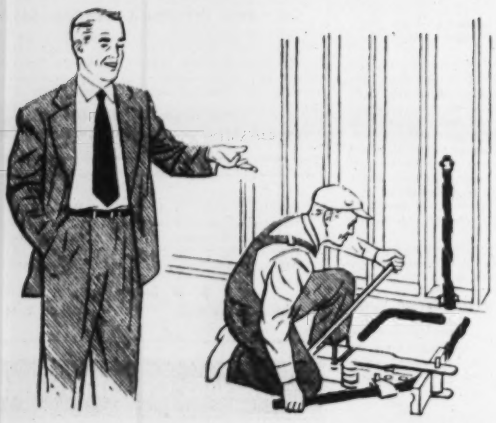

It costs less to do it right

—than to do it over!

When you specify pipe there are two things well worth remembering—

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but

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BYERS

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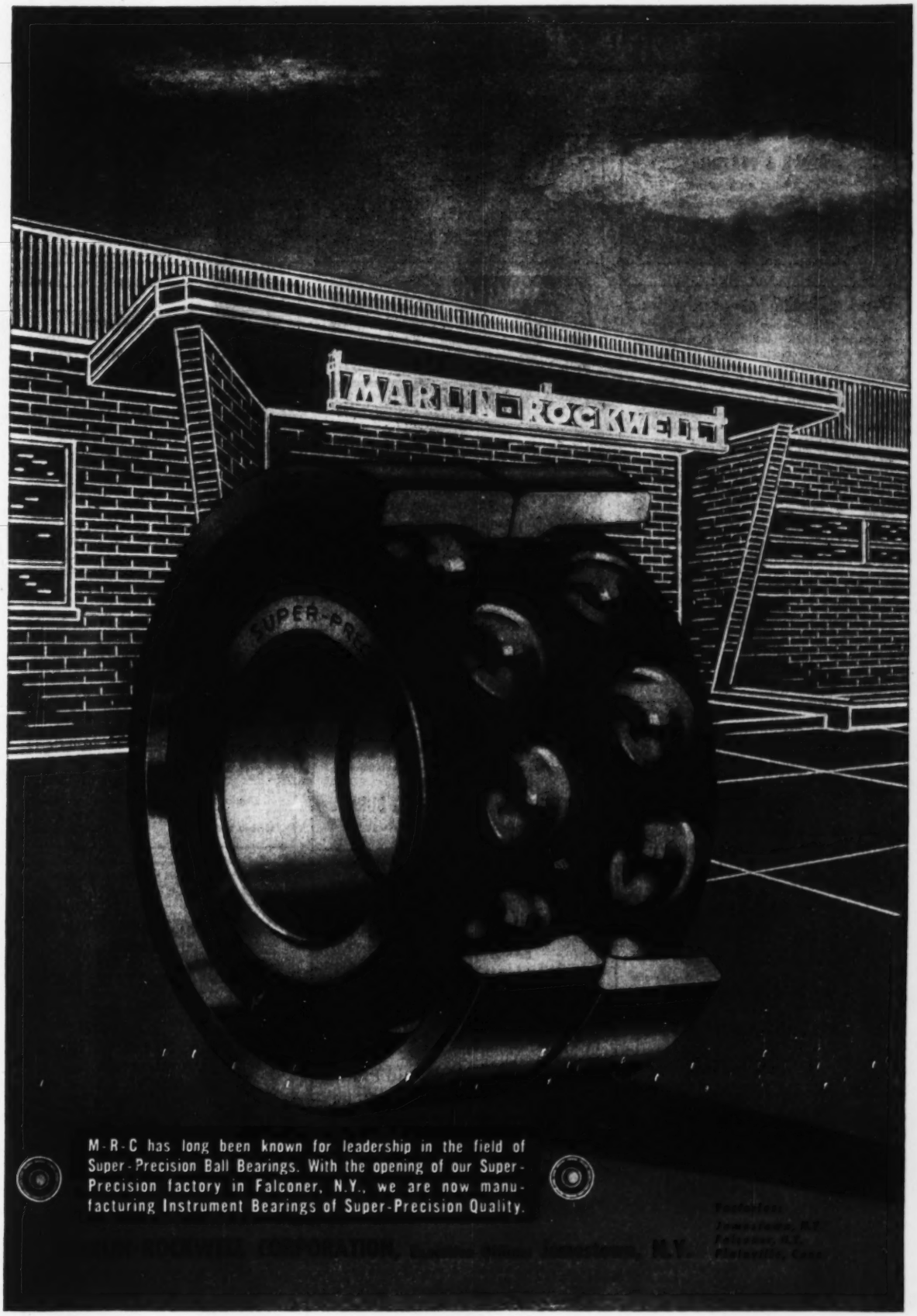

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MECHANICAL ENGINEERING, 29 W. 39th St., New York 18, N. Y.

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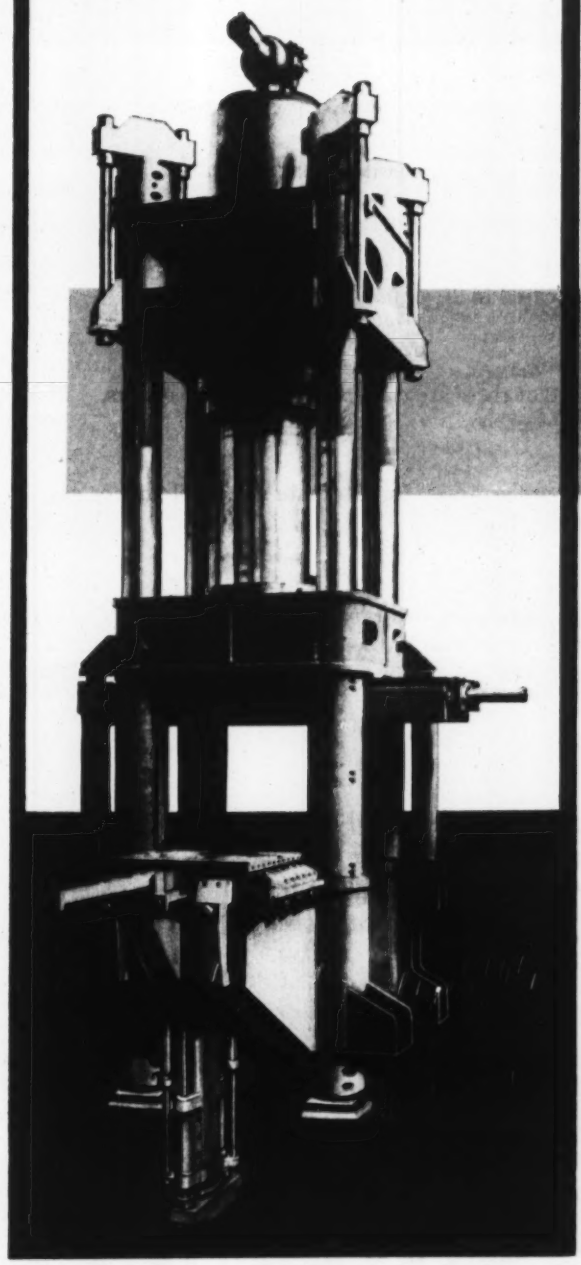
Reader Service Coupon For More Information

Go through the advertising pages and jot down the page numbers and names of advertisers about whose product you want additional information — mail the coupon to us — your request will be passed on to the advertiser promptly — you will hear directly from advertiser — saves your time in writing individual letters.

LOEWY—HYDROPRESS

FIRST



IN *HIGH-SPEED* HYDRAULIC FORGING PRESSES

FOR HIGH OUTPUT AND ECONOMICAL OPERATION

2,500 ton fast-working Hydraulic Long-Stroke Punching and Upsetting Press.
Part of a Loewy-Hydropress-built Forge Shop installation of special design.
Installed at the Green River Steel Corporation, Owensboro, Kentucky, the first plant to commercially produce sound ingots made by the Dornin Process.

WE BUILD

- Hydraulic Presses and Power Systems for the Steel and Non-Ferrous Industries.
- Open and Closed Die Forging Plants.
- Deep Drawing Single and Double Acting Presses.
- Extrusion Plants for Steel and Non-Ferrous Metals.
- Hot and Cold Rolling Mills for Steel and Non-Ferrous Metals.
- High-Pressure Pipe Testing and Expanding Machines.

LOEWY HYDROPRESS INC
ENGINEERS • CONTRACTORS

Rolling Mills • Hydraulic Presses • Pipe Testing Machines • Special Pipe Mill Equipment • Accumulators • Pumps • Die Casting Machines

350-M Fifth Avenue, NEW YORK 1, N. Y.

Birmingham • Chicago • Cleveland • Detroit • Los Angeles • Phoenix • San Francisco • Seattle • Washington, D. C. • Wheeling • Genoa, Italy • London, England • Madrid, Spain • Paris, France • Philippine Islands

C-E SERVICE TO UTILITIES in 1953 (4-million kilowatts)

In 1953 Combustion Engineering installed boilers to serve new utility generating capacity aggregating 4,129,000 kilowatts. This is more capacity than was installed by the entire utility industry in any year prior to 1948. The details follow:

NUMBER & SIZE There were 48 C-E Boilers serving turbine-generators ranging from 12,500 to 145,000 kw capacity.

LOCATION They are installed in 40 power stations located in 20 states. 14 are new stations.

TYPE Of the above total 30 are *reheat* units – 10 of these are *controlled circulation* boilers.

FUEL There are 33 coal-fired units of which 16 are arranged for alternate use of oil and/or gas. 13 units are designed to use oil or gas or both.

PRESSURES & TEMPERATURES Turbine throttle pressures range up to 2350 psi and steam temperatures to 1100 F. Nearly 40 per cent of the boilers are for operating pressures from 1500 psi up. All reheat units but one are for temperatures of 1000 F or higher.

Definite trends are apparent in this brief statistical record. Most significant is the fact that more than 60 per cent of these 1953 utility units are *reheat* units (nearly all of the larger units) and that one third of these are *controlled circulation* units.

COMBUSTION ENGINEERING, Inc.

Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y. B-715

BOILERS; FUEL BURNING AND RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS AND FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS; SOIL PIPE

Preventing high-volt leaks with **PERMUTIT** demineralized water

THE 75′ diameter atomic accelerator shown below has five times more power than any other. Its 2200 ton electromagnet quickly whips particles three million times 'round the race-track to an energy approaching 3 billion electron volts.

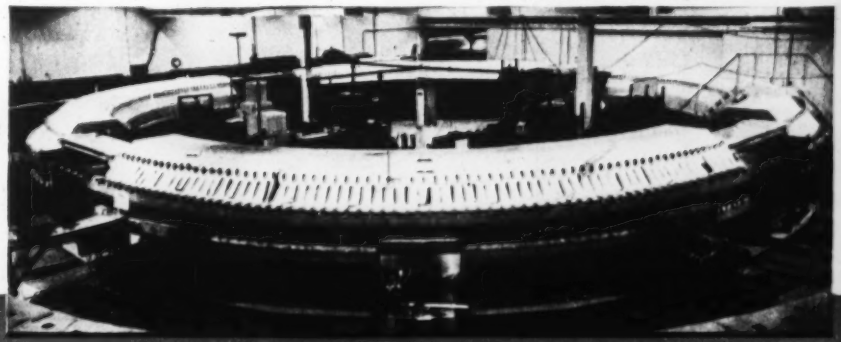
Packing all this power into a reasonable-size unit was a problem. Size ruled out air cooling. So the bus-bar magnet coil was made for circulating cooling water.

But at 3,000 volts, the dissolved minerals in *untreated* cooling water could conduct electricity, causing appreciable leakage to grounded piping. A means had to be found for producing water purer than conventional distilled water—at low cost.

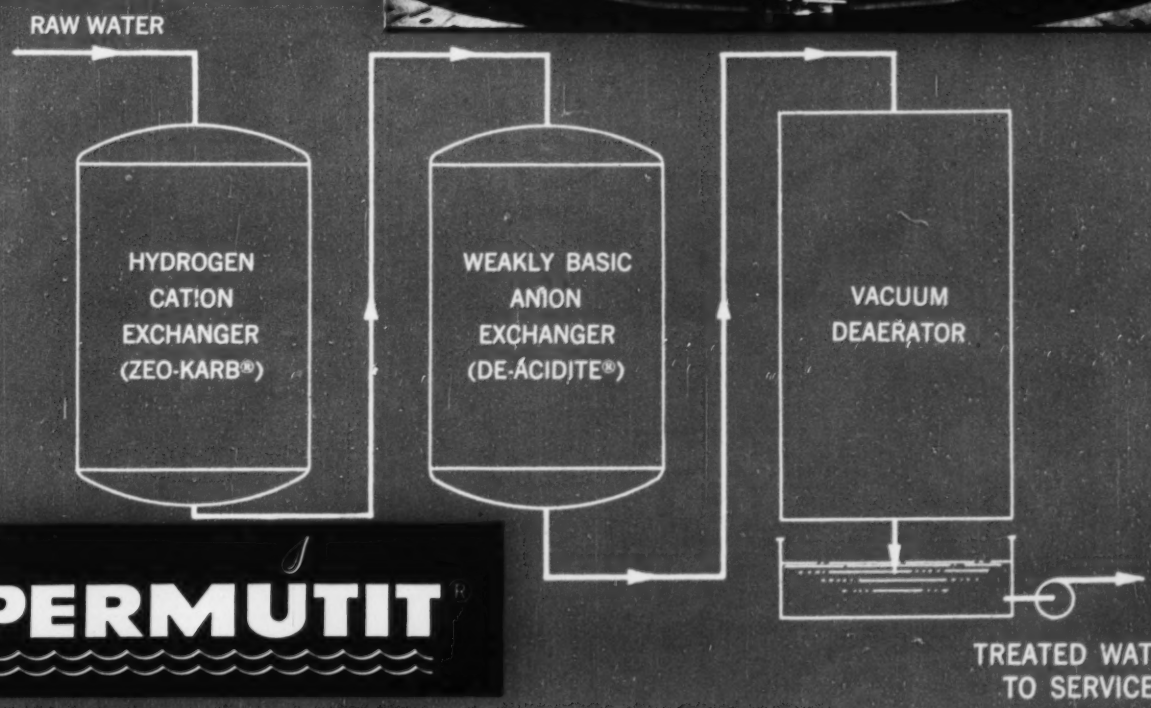
A Permutit Demineralizer was selected *(see diagram)*. Cooling water recirculated through this ion exchange unit approaches the very low conductivity of pure water, hence it has been completely effective in removing dissolved solids.

Find out how Permutit can solve your water problems. Write to THE PERMUTIT COMPANY, Dept. ME-2, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

The giant Cosmotron at Brookhaven National Laboratory.



Permutit two-step Demineralizer with Vacuum Deaerator. Troublesome cation impurities are removed in the first step, remaining minerals in the second, oxygen and CO_2 in the final.



PERMUTIT®

ION EXCHANGE AND WATER CONDITIONING HEADQUARTERS FOR OVER 40 YEARS

Bores, mills, drills, planes, shapes, gets precision from over 100 TIMKEN® bearings

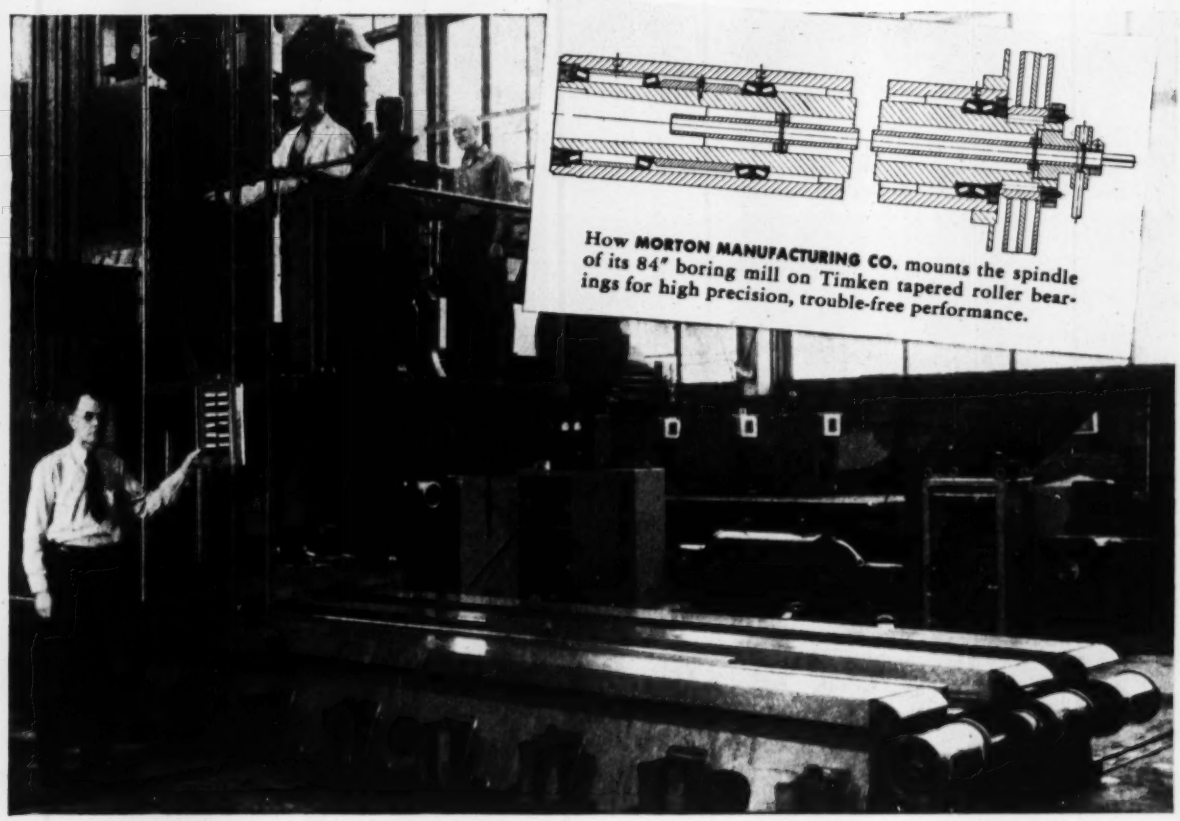
THIS Morton 84" boring mill not only does all the normal operations of boring, milling and drilling, but is fitted with a shaper head so it can do heavy draw-cut or push-cut planing and shaping operations. And it keeps its high precision during them all with more than 100 Timken® tapered roller bearings. They're located in the spindle, saddle, column, feed drive, traverse drive and spindle drive box.

Timken bearings have tapered construction that lets them take both radial and thrust loads, permits pre-loading to any desired degree. Deflection and end-play are minimized. Gears mesh smoothly. Long-lasting accuracy is assured.

The true rolling motion and incredibly smooth surface finish of Timken precision bearings practically eliminate friction. Timken bearings hold housings and shafts concentric, making closures more effective. Lubricant stays in—dirt stays out. Maintenance time and lube costs are cut.

Be sure to specify Timken precision bearings for the machine tools you build or buy. Look for the trade-mark "Timken" on every bearing. The Timken Roller Bearing Company, Canton 6, Ohio. Canadian plant: St. Thomas, Ontario. Cable address: "TIMROSCO".

This symbol on a product means its bearings are the best.



How **MORTON MANUFACTURING CO.** mounts the spindle of its 84" boring mill on Timken tapered roller bearings for high precision, trouble-free performance.

FINISHED TO CLOSER TOLERANCES

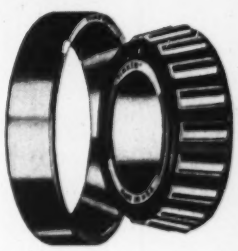
Finishing to incredible smoothness accounts for much of the precise, smooth rolling performance of Timken bearings. This honing operation is typical of the amazingly accurate manufacturing methods at the Timken Company.

The Timken Company is the acknowledged leader in: 1. advanced design; 2. precision manufacturing; 3. rigid quality control; 4. special analysis steels.

TIMKEN

TRADE-MARK REG. U.S. PAT. OFF.

TAPERED ROLLER BEARINGS



NOT JUST A BALL ○ NOT JUST A ROLLER ▭ THE TIMKEN TAPERED ROLLER ▭ BEARING TAKES RADIAL ↑ AND THRUST →○← LOADS OR ANY COMBINATION ✳